University of Alberta

A Comparison of Typical and Atypical Symptom Presentation in Acute Coronary Syndromes

by

Ann-Carol Comeau

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Nursing

Faculty of Nursing

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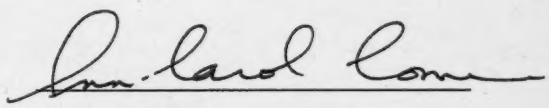

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "A Comparison of Typical and Atypical Symptom Presentation in Acute Coronary Syndromes" submitted by Ann-Carol Comeau in partial fulfillment of the requirements of the degree of Master of Nursing.

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Dedication

To my husband Mark and children, Christian and Hannah, who have supported me without fail throughout this process. Also, to my father, William Wedderburn, and in memory of my mother, Margery Wedderburn.

Abstract

The ability to recognize symptoms of acute coronary syndromes (ACS) is key to minimizing morbidity and mortality. The purpose of this prospective, cohort study was to compare typical and atypical symptoms in 100 patients presenting to a Chest Pain Program. Overall, 14% met the predetermined study criteria for typical presentation. Of the 31 patients with ACS, 74.2% had atypical presentations. Patients with typical presentations were more likely to have ACS than no ACS (χ^2 [1, N = 100] = 3.877, p = 0.031). Male gender, symptom location, and history of ischemic heart disease were associated with ACS. Although more men than women (76.2% vs. 70.0%), and more young than old patients (77.8% vs. 69.2%) with ACS had atypical presentations, these differences were not significant. There were no significant differences found due to symptom presentation or final diagnosis in age, BMI, ethnicity, or cardiovascular risk factors. Clinicians should not rely on classic descriptions of angina when evaluating patients with symptoms suspicious for ACS.

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CHAPTER ONE

Introduction

The health care burden of heart disease is enormous and will likely worsen as a large cohort of the population ages. An estimated eight million people, or one in four Canadians, are living with some form of cardiovascular disease (Heart and Stroke Foundation of Canada, 2001). Recent statistics list cardiovascular disease as the leading cause of death in Canada accounting for 78,942 deaths in 1999, the majority (54%) attributed to coronary artery disease (Statistics Canada, 2002a). Circulatory diseases are the most common cause of death (36%) for the Capital Health Region (Predy, 2003). Furthermore, the cost of cardiovascular disease in Canada was estimated to be in excess of 18 billion dollars per year (Heart and Stroke Foundation of Canada, 2001).

On the positive side, the incidence of acute myocardial infarction (AMI) in Canadians age 25 – 74 years decreased to 41,400 in 1997, down from 54,600 in 1984, a decline of 24%. Death from AMI also decreased by 21% (Heart and Stroke Foundation of Canada, 2001). This reduced mortality is due in part to advances in therapy, including fibrinolytics and percutaneous revascularization (Kucia, Taylor, Dip, & Horowitz, 2001). In many ways, cardiac disease has changed from an acute to a chronic illness. Survivors often face ongoing cardiac disability including angina, heart failure, or repeat AMI. In fact, recurrent AMI increased 13% over this same 13-year time period (Heart and Stroke Foundation of Canada, 2001).

Patients with acute coronary syndromes (ACS), that is, AMI and unstable angina, often present to the emergency department (ED) (Hill & Geraci, 1998). In the Capital Health Region, circulatory diseases ranked 5th (4.6%) for reasons to visit the ED (Predy,

2003). Up to one-third of patients who present to the ED with chest pain have ACS as the etiology (Wilkinson & Severence, 2001). The ability to recognize signs and symptoms of ACS on initial presentation is key to minimizing morbidity and mortality (Ting et al., 1991). In their examination of malpractice claims against emergency physicians in Massachusetts, Karcz et al. (1996) cited missed AMI as the claim with the highest percentage (25.47%) of dollar loss of any category of high-risk malpractice claims.

Clinical assessment of a patient's chest pain history is usually done by comparing their symptoms with features considered classic of discomfort caused by coronary atherosclerosis. The American College of Cardiology/American Heart Association/American College of Physicians – American Society of Internal Medicine defines 'typical' or definite angina as: 1) substernal chest discomfort (may radiate to neck, jaw, epigastrium, or arms) with a characteristic quality (squeezing, pressurelike, heavy) and duration (usually 2 – 20 minutes), 2) precipitated by physical exertion or emotional stress, and 3) relieved by rest or nitroglycerin. 'Atypical' or probable angina has two of these three criteria, and 'non-cardiac' or nonspecific chest pain has one or none (Gibbons et al., 1999). The World Health Organization definition for the diagnosis of AMI, the current standard, includes among its three criteria the presence of chest pain (Wilkinson & Severence, 2001).

Discomfort above the jaw, below the epigastrium or localized to a small area is considered unlikely to be cardiac in origin, as is fleeting, pleuritic or positional pain (Braunwald et al., 2000; Gibbons et al., 1999; Lee et al., 1985; Jesse & Kontos, 1997). Unlike chronic stable angina, pain with AMI or unstable angina may occur at rest and be prolonged (Braunwald et al., 2000). However, pain that lasts for hours without

biochemical or electrocardiographic evidence of myocardial damage is unlikely cardiac (Lee, 2002). Clinicians who rely too heavily on these criteria may miss the diagnosis of ACS when patients present without typical chest pain (Zarling, Sexton, & Milnor, 1983). Murata (1993) stated, "The clinical manifestations of myocardial infarction vary widely, and the prognosis is worse for patients whose presentations are atypical" (p. 67).

Patients experiencing ACS can present with a multitude and variety of symptoms. While research has shown patients may present atypically with ACS, classic symptoms of myocardial ischemia are still given merit in the clinical setting, while atypical symptoms often are not. Furthermore, the detailed characteristics of presenting symptoms remain largely unknown. Understanding the factors associated with atypical presentation may assist in the earlier identification and treatment of patients with ACS.

Purpose of the Study

The purpose of the study was to examine the presentation of ACS versus no ACS (NACS); specifically, the difference between individuals that present to the ED with typical versus atypical symptoms. The research questions addressed were:

1) What is the incidence of typical and atypical presentations in individuals with ACS and NACS?
2) What is the relationship between typical and atypical presentation and the diagnosis of ACS and NACS?
3) When individuals presented atypically, what are the presenting symptoms and their characteristics?
4) What is the relationship between cardiovascular risk factors (CRF) and typical and atypical presentation, and between CRF and the diagnosis of ACS and NACS?

5) What is the relationship between history of ischemic heart disease (IHD) and typical and atypical presentation, and between IHD and the diagnosis of ACS and NACS?
6) What is the relationship between health care seeking behavior for similar symptoms within 30 days prior to the current presentation and typical and atypical presentation, and between health care seeking behavior and the diagnosis of ACS and NACS?
7) What is the relationship between diagnostic findings and typical and atypical presentation, and between diagnostic findings and the diagnosis of ACS and NACS?

Definition of Terms

Typical Presentation – Chest pain or discomfort that was substernal or retrosternal (may radiate to neck, jaw, epigastrium, or arms) with a characteristic quality (squeezing, pressurelike, heavy), may be reproducible by physical exertion or emotional stress, and usually relieved with rest or nitroglycerine (Gibbons et al., 1999); chest pain may have occurred at rest (Braunwald et al., 2000). Not all patients use the term pain to describe their symptoms; in fact, patients with a diagnosis of ACS often say they do not have pain but discomfort or an uneasy feeling (Gibbons et al., 1999; Lee, 2002).

Atypical Presentation – Patients with ACS who presented without typical chest pain or with a symptom other than chest pain, for instance, arm pain, dyspnea, syncope, etc.

Acute Coronary Syndromes – A clinical syndrome usually caused by disruption of an atherosclerotic plaque in the coronary artery resulting in activation of the coagulation cascade and subsequent partial or complete occlusion of the vessel by thrombus and/or spasm. Acute coronary syndromes encompass AMI, both ST elevation myocardial

infarction (STEMI) and non-ST elevation myocardial infarction (NSTEMI), and unstable angina (UA). For the purposes of this study, ACS referred to NSTEMI and UA only as patients with STEMI were not included in the study population. Non-ST elevation myocardial infarction differs from UA in that there is subsequent evidence of myocardial necrosis detected by release and measurement of chemical markers in the bloodstream. Changes in the electrocardiogram (ECG) (dynamic ST depression or T wave changes) may be present with either condition but tend to be transient with UA and may or may not persist with NSTEMI (Braunwald et al., 2000).

Cardiovascular Risk Factors – Factors that increase a person's risk of developing cardiovascular disease including: advanced age (≥ 65 years), diabetes mellitus, male gender, hyperlipidemia, hypertension, obesity (body mass index > 27 [Higgins, Kannel, Garisson, Pinsky, & Stokes, 1988; Kannel, 1996]), positive family history in a primary relative (parent or sibling; male ≤ 55, female ≤ 65), and smoking history within the past five years (Libby, 2001).

Diagnostic Findings – The ECG was considered positive if there was new, transient ST depression of ≥ 0.05 mV or T wave inversion ≥ 0.2 mV (Braunwald et al., 2000). Positive chemical markers include CK-MB ≥ 10 µ/L plus CK-MB/CK ratio ≥ 0.05 µ/L, or Troponin I ≥ 0.15 µ/L at either the initial or 6-hour measurement (University of Alberta Hospital laboratory reference values). The exercise treadmill test (ETT) was positive if there was evidence of ≥ 1.0 mm flat or downsloping ST depression 60 – 80 milliseconds after the end of the QRS complex (Gibbons et al., 2002). Nuclear Perfusion Imaging (MIBI) was positive when reported by the Radiologist as having a reversible perfusion defect or area of ischemia (Wackers, Soufer, & Zaret, 1997). Stress echocardiography was positive

when reported by a Cardiologist as having regional wall motion abnormalities induced by exercise (Feigenbaum, 1997).

Health Care Seeking Behavior – Medical attention, at a primary health care provider, community or tertiary centre, sought within the previous 30 days for similar symptoms as current presentation.

History of Ischemic Heart Disease – Previously documented diagnosis of AMI or coronary artery disease.

Significance of the Study

The information gained from this study enhances the current knowledge of the presentation of ACS, particularly the presentation of patients at the Emergency Department of the University of Alberta Hospital. Although the presentation of ACS has previously been studied, little has been documented in a prospective manner about specific presenting symptoms in the absence of typical chest pain and among patients with an ACS diagnosis other than STEMI. The study provided detailed information about presenting symptoms, as well as further insight into whether female gender and advanced age or other cardiovascular risk factors are related to an atypical presentation. A better understanding of the factors associated with atypical presentation may assist in the earlier identification and treatment of patients with ACS.

CHAPTER TWO

Literature Review

A literature search using MEDLINE and CINAHL databases from 1965 to present was conducted, using keywords 'acute coronary syndrome', 'myocardial infarction', 'chest pain', 'atypical', 'typical', 'presentation', 'symptom', 'angina', and 'unstable angina'. Symptom characteristics on presentation with acute coronary syndromes (ACS), as well as missed acute myocardial infarction (AMI) were reviewed. Gender and age related differences were also examined.

Symptom Characteristics on Presentation with Acute Coronary Syndromes

The word angina derives from the greek word, anchein, meaning to choke. The origin of the word is also shared with anxious and anguish (Matthews, 1977). The first known use of the term 'angina pectoris' was by William Heberden in 1768, in his landmark address to the Royal College of Physicians of London, entitled 'Some Account of a Disorder in the Breast'. Michaels (2001) quotes Heberden,

> Those who are afflicted with it are seized, while they are walking and more particularly when they walk soon after eating with a painful and most disagreeable sensation in the breast, which seems as if it would take their life away if it were to increase or to continue; the moment they stand still, all this uneasiness vanishes...the os sterni is usually pointed to as the seat of the malady...always inclining more to the left side, and sometimes there is joined with it a pain about the middle of the left arm (p. 9).

A definite link between angina and the heart was established in the early 1900s by Herrick (1912), in his classic account of the clinical manifestations of acute, non-fatal coronary artery obstruction. He described a crushing, substernal chest pain in

association with coronary thrombosis. However, he also noted the common presence of other symptoms including dyspnea, diaphoresis, nausea, and vomiting. Furthermore, he stated acute coronary obstruction might occur without pain.

The majority of patients with ACS (53 – 74%) present to hospital with chest pain (Canto et al., 2000; Gupta et al., 2002; Horne, James, Petrie, Weinman, & Vincent, 2000; Lehmann, Werner, Lehmann, & Savory, 1996; Uretsky, Farquhar, Berezin, & Hood, 1977). Those who present with atypical symptoms or without chest discomfort are often considered at low risk for having coronary ischemia (Lee et al., 1985; Murata, 1993; Jesse & Kontos, 1997). This latter group of patients had up to double the delay time (2.6 – 6.7 hours longer delay) before presenting to hospital (Canto et al., 2000; Horne et al., 2000). They were also less likely to receive therapy; i.e., 60.4% of patients without chest pain received aspirin vs. 84.5% with chest pain (Canto et al., 2000). More patients in this group (1.9 % to 25%) were discharged inadvertently from the emergency department (ED) (Kannel & Abbott, 1984; McCarthy, Beshansky, D'Agostino, & Selker, 1993; Pope et al., 2000), and they had higher mortality rates; i.e., 23.3% in-hospital mortality vs. 9.3% in the chest pain group (Canto et al., 2000).

Many studies over the past three decades have shown patients, later proven to have ACS, can present with an atypical picture, that is, without meeting the classic criteria for 'typical' angina (Canto et al., 2000; Lee et al., 1985; Madias, Chintalapaly, Choudry, Chalavarya, & Kegan, 1995; Then, Rankin, & Fofonoff, 2001). In 1977, Uretsky and colleagues showed 26 of 102 people with AMI had chief complaints other than chest pain including dyspnea (14), abdominal pain (5), and fatigue (4). Of note, the mortality of the 25.5% of patients without pain was substantially higher (50%) than those with pain (18%) ($p < 0.05$).

In an attempt to define a low risk group for ACS, another of the earlier studies examined the symptom characteristics of patients (n = 596) presenting to ED with chest pain (Lee et al., 1985). The authors found patients who described their pain using atypical terms, such as 'burning' or 'indigestion', were just as likely to have AMI as those who used the word 'pressure'. 'Sharp' and 'stabbing' descriptors of pain were least predictive of AMI. Yet, of patients subsequently found to have AMI, up to 22% presented with sharp or stabbing pain, 13% with some pleuritic quality, and 7% with reproducible pain on palpation, all characteristics generally considered to indicate non-cardiac pain (Gibbons et al., 1999). The authors did not analyze the descriptors of pain for prediction of AMI in terms of women versus men or by age group. Wilkinson and Severence (2001) warn placing an over emphasis on quality or description of pain can be dangerous as there may be social, geographical, or cultural differences in a patient's choice of words. Verbal descriptors of pain may also differ among men and women, with women often using stronger emotive language such as 'worrying' and 'frightening' (Albarran, Durham, Chappel, Dwight, & Gowers, 2000).

In a prospective study of a consecutive series of patients admitted to the coronary care unit, Madias and colleagues (1995) found 40 out of 501 (8%) patients with AMI when interviewed on admission presented without pain. These 40 patients presented with nonspecific symptoms such as dyspnea, syncope, or nausea. Patients with 'painless' AMI were older (p = 0.0005), more commonly had prior AMI (p = 0.049) or diabetes (p = 0.004), and had a lower prevalence of prior angina (p = 0.025). Interestingly, these patients also presented with a higher rate of pulmonary congestion (p = 0.000005), cardiomegaly (p = 0.0002), and left ventricular hypertrophy (p = 0.000005) compared with patients with pain. Other cardiac risk factors including

gender, smoking, hypertension, and cholesterol status were not significantly different between the two groups. This study placed patients with pain in other areas of the body that would generally be considered atypical (ears, abdomen and flank) in the same cohort as those with pain more commonly associated with ACS (chest, arm and jaw pain). This may account for the lower percentage of patients in the AMI group without pain compared with other studies that have examined atypical presentation using different criteria.

One of the largest and most recent studies to look at characteristics of patients presenting with AMI was the prospective, observational study conducted by Canto, Shlipak, and colleagues (2000) using the National Registry of Myocardial Infarction 2 data. The registry included 1674 hospitals in the United States and 434,877 patients hospitalized with confirmed AMI, covering a four-year period from 1994 to 1998. Chest pain was defined as chest discomfort, sensation or pressure, or arm, neck or jaw pain. Absence of chest pain was defined as, but not limited to, dyspnea, nausea or vomiting, palpitations, syncope, or cardiac arrest. One-third of patients (n = 142,445) did not have chest pain on presentation. This group was approximately seven years older than the chest pain group, had a higher percentage of women (49.0% vs. 38.0%), diabetics (32.6% vs. 25.4%) and prior heart failure (26.4% vs. 12.3%), had a longer delay prior to presentation (7.9 vs. 5.3 hours), were less likely to have a confirmed diagnosis of AMI on admission (22.2% vs. 50.3%), and were less likely to receive thrombolysis or primary percutaneous intervention (PCI) (25.3% vs. 74.0%), aspirin (60.4% vs. 84.5%), beta blockers (28.0% vs. 48.0 %), or heparin (53.4% vs. 83.2%). Finally, the no chest pain group had an in-hospital mortality rate of 23.3% compared with 9.3% in the chest pain group. All of these findings were statistically significant ($p < 0.001$). Unfortunately, the

specific symptom of the patients in the no chest pain group was not abstracted from the data so further analysis by symptom was not possible.

Gupta, Tabas, and Kohn (2002) attempted to overcome this limitiation of Canto, Shlipak and colleagues' study (2000) by not only identifying the prevalence of atypical presentation in AMI patients but also by describing the type and frequency of atypical symptoms. Only 53% of AMI subjects, 380 out of 721, had typical symptoms which they defined broadly by including all types of chest pain, as well as neck, jaw and left shoulder or arm pain. Atypical presenting symptoms included shortness of breath (17%), cardiac arrest (7%), dizziness/weakness/syncope (4%), abdominal pain (2%), and other (17%). The highest risk of presentation with atypical symptoms was in the over 84 year age group (multivariate *OR* 5.76; 95% *CI* 3.06 to 10.83). Women had a higher likelihood than men of atypical presentation (multivariate *OR* 1.59; 95% *CI* 1.11 – 2.28).

Most studies have examined symptom presentation in AMI patients. Canto, Fischer, et al. (2002) investigated atypical presentations in patients with unstable angina (UA). They examined the health records of 4,167 Medicare patients admitted to 22 Alabama hospitals between 1993 and 1999. Their definition of typical presentation included substernal left or right chest pain that was squeezing, tight, aching, crushing, dull, full, heavy, or pressure, or arm discomfort which was aggravated by exercise and relieved by rest or nitroglycerine. Atypical presentation was the absence of a typical presentation. Over half of UA patients (n = 2156, 51.7%) had atypical presentations, with 14.4% of these (n = 310) experiencing atypical chest pain that was burning, sharp or pleuritic in nature. Other atypical symptoms included shortness of breath (69.4%), nausea (37.7%), diaphoresis (25.2%), syncope (10.6%), and pain in areas other than the chest including, both arms (11.5%), epigastrium (8.1%), shoulder (7.4%), or neck

(5.9%). Logistic regression analysis identified two independent predictors of UA and atypical presentation including older age (*OR* 1.09; 95% *CI* 1.10 to 1.17 per decade of life) and history of dementia (*OR* 1.49; 95% *CI* 1.10 to 2.03). There were no significant differences between typical and atypical presentation and in-hospital mortality ($p = 0.4$).

Missed Diagnosis of Acute Coronary Syndromes

Several studies evaluated the incidence of misdiagnosis of ACS and inappropriate discharge from the ED, and the relationship to atypical presentation. Kannel and Abbott (1984) reviewed 30 years of Framingham follow-up data and found evidence of more than 25% missed AMI based on development of electrocardiographic (ECG) findings consistent with infarction. More recently, a case control study by McCarthy et al. (1993) compared patients with missed AMI with control patients either admitted with AMI or discharged without AMI; only 1.9% or 20 of 1050 patients had missed AMI.

Pope and colleagues (2000) studied 10,689 patients who presented to the ED with chest pain or other symptoms suggestive of ACS. Myocardial infarction occurred in 889 of these patients with a 2.1% ($n = 19$) rate of failure to diagnose and subsequent mistaken discharge. Of the 966 patients with unstable angina, 2.3% were inappropriately discharged. Multivariate analysis in the Pope et al. (2000) study showed a failure to admit the AMI patients to hospital was significantly related to being nonwhite ($p = 0.03$), female of less than 55 years of age ($p = 0.02$), normal or nondiagnostic ECG ($p < 0.001$), and a chief symptom of shortness of breath ($p = 0.02$).

Zarling et al. (1983) retrospectively reviewed 100 consecutive cases of AMI proven on autopsy. They discovered only 53% of these had the correct antemortem diagnosis. Of the 47 undiagnosed cases, 26% did not have a history suggestive of AMI. Clinical presentations were divided into 4 groups: 1) typical retrosternal chest pain with

confirming enzymes and/or ECG findings (*n* = 27; 85% correct antemortem diagnosis), 2) typical retrosternal chest pain without confirming enzymes and/or ECG (*n* = 27; 52% correct antemortem diagnosis), 3) atypical presentation including epigastric pain, syncope, arrhythmia, shock, pulmonary edema, and weakness (*n* = 26; 38% correct antemortem diagnosis), and 4) concealed history including stroke, coma, anesthesia, or no symptoms (*n* = 16; 19% correct antemortem diagnosis). While several studies have focused on missed AMI, little is known about the incidence of misdiagnosis of UA.

Gender Related Differences in Symptom Presentation

The literature strongly suggests women have a different experience of heart disease than men. Women develop heart disease later in life (Jensen & King, 1997), have a different endocrine profile particularly in relation to menopause and its possible link to lipid metabolism, and have a higher risk of heart disease if diabetic (Gregor et al., 1994). Several studies have demonstrated women were less likely than men to have typical symptoms of AMI (Goldberg et al., 1998; Gupta, Tabas, & Kohn, 2002; Karlson, Herlitz, & Hartford, 1994; Meischke, Larsen, & Eisenberg, 1998; Penque et al., 1998; Warner, 1997).

Conversely, Kudenchuk and colleagues (1996) found no significant difference in AMI presentation or delay based on gender; 99% of patients (*n* = 1097; 851 men and 246 women) had chest pain on presentation. However, all subjects in the study were obtained from the Myocardial Infarction Triage and Intervention Project registry, met criteria for thrombolysis, and were received via ambulance, perhaps biasing the sample toward those that had more severe and typical symptoms. The authors did find that women were not as likely to receive thrombolysis, or to undergo coronary angiography, percutaneous coronary intervention (PCI), or coronary artery bypass graft surgery

(CABG) ($p < 0.001$). The rate of in-hospital complications was equal for both sexes, but women had almost twice the in-hospital mortality compared with men, even after adjustment for age and other baseline characteristics.

Lehmann and colleagues (1996) evaluated patients presenting with new onset chest pain by retrospectively reviewing 311 patient charts. Their focus was on the 'first signs' of cardiac disease in men ($n = 145$) versus women ($n = 166$). There were only two statistically significant differences in symptom presentation between the two groups; women were more likely to present more than six hours after symptoms onset ($p < 0.05$) and to complain of pleuritic pain ($p < 0.05$). However, men were treated more aggressively including a higher rate of cardiac marker measurement, Cardiology consult, and treatment with nitroglycerine, aspirin, heparin and fibrinolysis. Women more often received anxiolytics and narcotics. This bias could in part be explained by the fact that men more often manifested acute ECG abnormalities.

A recent study by Milner, Funk, Arnold, and Vaccarino (2002) examined typical and atypical symptom presentation to evaluate whether symptoms were predictive of ACS, including AMI and UA, in women versus men. They studied 246 women and 276 men, prospectively documenting their symptoms verbatim; 36% ($n = 89$) of women and 45% ($n = 124$) of men were eventually diagnosed with ACS. "Adjusted relative risk for ACS associated with typical symptoms in women compared with men were close to 1.0, indicating no sex differences" (p. 283). They concluded typical symptoms were the strongest symptom predictors of ACS in women. However, their definition of 'typical' symptoms was very broad and included symptoms such as diaphoresis and arm or shoulder pain which in many studies would be considered atypical.

Although the incidence of ACS is lower in women than men, clinicians may perceive women who present atypically as having an even lower likelihood of ACS, which in turn may affect treatment and outcomes (Green & Ruffin, 1993; Raine, Crayford, Chan, & Chambers, 1999). In several studies, women received less aggressive treatment and investigation (Gregor et al., 1994; Kudenchuk et al., 1996; Lehmann et al., 1996; Marrugat et al., 1998; Penque et al., 1998), were less likely to be admitted to hospital (Cunningham et al., 1989; Silbergleit & McNamara, 1995), and if admitted were less likely to go to a coronary intensive care unit (Green & Ruffin, 1993). Raine et al. (1999) retrospectively reviewed charts of 715 patients admitted with AMI. Their findings suggested women (n = 259) were less likely to receive exercise stress testing (adjusted odds ratio 0.58; 95% *CI*, 0.40 – 0.84) or coronary catheterization (adjusted odds ratio 0.62; 95% *CI*, 0.39 – 0.99), investigations that lead to revascularization therapies. However, once investigated they were as likely as men to be referred for PCI or CABG. In their study, significantly more men (89%) than women (80%), independent of the effect of age, were still alive one year after admission (p = 0.001).

Perhaps as a result of less aggressive treatment and investigation, women have been shown to have higher short and long-term mortality following AMI (Marrugat et al., 1998). The study by Karlson et al. (1994) demonstrated women had significantly higher in-hospital mortality than men (19% vs. 12%; $p < 0.01$), as well as higher total one-year mortality (36% vs. 25%; $p < 0.01$) following AMI. However, following multivariate analysis, female gender was not an independent risk factor for death but increased mortality was accounted for by increased age. One-year morbidity was not different for men and women.

Women may delay longer in seeking healthcare with AMI in part due to the atypical nature of their symptoms (Dempsey, Dracup, & Moser, 1995; Lefler, 2002; Karlson et al., 1994; Meischke, Larsen, & Eisenberg, 1998; Rosenfeld, 2001). Meischke et al. (1999) investigated how women label and intend to respond to common and less common symptoms of AMI. They conducted telephone interviews with 862 women from the community over the age of 50 years. They suggested women might be at risk of not seeking care if they mislabel their symptoms, and stress the importance of educating women about the less common AMI symptoms. As well, Hofgren, Karlson, and Herlitz (1995) prospectively studied 914 patients (652 men; 262 women) admitted to the coronary care unit with suspected AMI to evaluate the occurrence of prodromal symptoms; 70% of women reported prodromal symptoms versus 58% of men ($p < 0.05$). Lefler (2002) summarizes, "Gender bias from within (women do not perceive themselves susceptible) or externally from gender treatment bias within the health care system, also contribute to increased morbidity and mortality" (p. 454).

Age Related Differences in Symptom Presentation

The majority of patients with AMI are elderly (Paul et al., 1996). In fact, the older a person is, the higher the rate of death from AMI, peaking at age 75-79 for men and 80-84 for women (Statistics Canada, 2001). Tresch and Alla (2001) noted myocardial ischemia is often not diagnosed in the elderly until they suffer an AMI due to their atypical presentation and lack of classic features. Myocardial ischemia without chest pain is more prevalent in older patients (Applegate, Graves, Collins, Vander Zwaag, & Akins, 1984; Madias et al., 1995; Uretsky et al., 1977). This difference may be due to age-related structural and physiological changes to the cardiovascular system (Tresch & Aronow, 1996). Many theories of why perception of chest pain may be diminished or

absent in the elderly abound including co-morbid diseases, such as diabetes mellitus, causing neuropathies, an alteration in the pain threshold, or generalized autonomic dysfunction (Cocchi et al., 1988; Thompson, Wood, & Wallhagen, 1992).

Myocardial ischemia may also present as heart failure or pulmonary edema; dyspnea is a common presenting symptom of AMI in the elderly (Applegate et al., 1984; Tresch & Aronow, 1996). Tresch and Aronow (1994) noted,

> This frequent complaint of dyspnea associated with coronary artery insufficiency in the elderly has been explained by an elevated end diastolic left ventricular pressure secondary to an ischemia-induced decrease in ventricular compliance superimposed on the diminished compliance that occurs secondary to normal aging. (p. 289)

Other prominent manifestations of ACS include syncope, cerebrovascular accident and acute confusion (Thompson et al., 1992). As well, sudden death as the initial presentation increases with age (Tresch & Aronow, 1996).

Milner, Funk, Richards, Vaccarino, and Krumholz (2001) conducted a secondary analysis of observational data collected on patients (n = 531) who presented to the ED with symptoms suggestive of ACS. Typical symptoms were defined broadly and included chest, neck, jaw, shoulder or arm pain, dyspnea and diaphoresis; atypical and associated symptoms included right-sided chest pain, mid back pain, arm numbness, nausea and vomiting, dizziness, fatigue, and palpitations. Bivariate analysis demonstrated typical symptoms to be predictive of ACS in younger patients ($p < 0.01$). However, no symptoms were significantly associated with ACS in those over 70 years of age.

In the Framingham Heart Study, nearly one-half of the 25% of unrecognized AMI were silent; 42% of silent infarcts were in men age 75 to 84 years (Kannal & Abbott,

1984). Solomon and colleagues (1989) Multicenter Chest Pain Study compared the presentation of AMI and unstable angina in 5109 patients under the age of 65 with 2625 patients over 65 years of age. Elderly patients were significantly less likely to have typical features of AMI (i.e., substernal location $p < 0.001$; pressure quality $p < 0.0001$) and typical features were less predictive of AMI in this population. Analysis for the combined endpoint of AMI and unstable angina resulted in similar findings as AMI alone. The study is limited in that it only included patients presenting with the symptom of acute chest pain.

As with women, the typical or predominant presentation for the elderly is often not typical in the classic sense. This is thought to predispose the elderly to higher rates of misdiagnosis and missed or delayed treatment, resulting in more complications including death (Applegate et al., 1984; Cocchi et al., 1988; Tresch & Aronow, 1996). Paul and colleagues (1996) prospectively studied 561 consecutive patients with AMI to compare risk factor profiles, presentation, management, and hospital outcome of the very elderly ($\geq$ 75 years), the elderly (66 – 74 years), and younger ($\leq$ 65 years). The very elderly more commonly experienced heart failure (40% vs. 14%; $p < 0.00001$) and non-Q wave AMI (76% vs. 56%; $p < 0.005$). This same group less frequently received thrombolysis (9% vs. 34%; $p < 0.0001$; all patients withheld thrombolysis had contraindications to therapy), coronary angiography (35% vs. 73%; $p < 0.00001$), PCI (9% vs. 31%; $p < 0.0002$), and CABG (5% vs. 15%; $p < 0.03$). Mortality was higher in the very elderly compared to the other two groups (19% vs. 5%; $p < 0.004$).

Coronary heart disease is one of the most prevalent diseases of the elderly and also the number one killer for males over the age of 70 and females over the age of 75 (Statistics Canada, 2001; Tresch & Aronow, 1994). As presented, diagnosis of AMI may

be particularly difficult in the elderly because it often manifests without typical chest pain (Solomon et al., 1985; Thompson et al., 1992; Tresch & Aronow, 1994; Uretsky et al., 1977). Atypical symptoms are even more common in the over 85 age group (Thompson et al., 1992). The elderly have a higher incidence of missed AMI, are treated less aggressively, and experience higher mortality (Kannel & Abbott, 1984; Paul et al., 1996).

Summary

The body of literature on symptom presentation with ACS has several limitations. First, the definition of typical and atypical symptoms varies widely, for instance, dyspnea may be included as typical in one study and atypical in another. Some studies simply evaluated whether a person had chest pain or no chest pain, disregarding all other symptoms. This lack of conformity results in contradictory findings. Second, the majority of studies focus on AMI with little emphasis on symptom presentation with UA. There may be subtle differences in the symptom predictors of ACS between these two groups. Ruling out AMI can be fairly straight forward when a protocol of observation and investigation is utilized, however ruling out UA, which in some cases may be a prodrome to AMI, can be more elusive. Third, there is a dearth of Canadian research; the ACS experience of Canadians may differ from that of other nations. Finally, the majority of studies were done retrospectively using chart review or registry data.

Despite numerous studies over several decades demonstrating patients with ACS often present without typical symptoms, patients are often deemed low risk for ACS by clinicians when they present without typical chest pain (Canto et al., 2000; Lee et al., 1985; Madias et al., 1995). As well, patients may ignore symptoms of an atypical nature (Dempsey, Dracup, & Moser, 1995; Karlson et al., 1994; Lefler, 2002; Meischke, Larsen, & Eisenberg, 1998; Rosenfeld, 2001).This may result in a failure to diagnose ACS or a

delay in appropriate treatment, thereby increasing morbidity and mortality (Canto et al., 2000; Horne et al., 2000; Ting et al., 1991). Warner (1997) concluded, "Although certain elements from the history and clinical characteristics of the pain or symptoms increase or decrease the likelihood of a life-threatening etiology, all patients deserve a careful and thorough assessment" (p. 89).

CHAPTER THREE

Method

The purpose of this study was to examine the symptoms of patients presenting with acute coronary syndromes (ACS), specifically, whether symptoms met typical criteria. As well, relationships between symptom presentation and the diagnosis of ACS, cardiovascular risk factors, history of ischemic heart disease, and health care seeking behavior for similar symptoms within 30 days prior to current presentation were determined.

Design

A prospective, comparative design (cohort study) was used to examine the differences between patients with typical and atypical presentations of ACS.

Sample/Setting

The sample for this study was obtained from all patients who presented to the Emergency Department (ED) at the University of Alberta Hospital and were enrolled in the Chest Pain Program (CPP) (Appendix A). Exclusion criteria included: 1) inability to provide a history of the presenting symptom; i.e., does not speak English, 2) under 18 years of age, 3) failure to complete the CPP; i.e., discharged against medical advice, and 4) patients not meeting inclusion criteria for the CPP because they were considered low risk for ACS or had high risk features, including patients presenting with ST elevation myocardial infarction.

The purpose of the University of Alberta Hospital ED based CPP is to identify and evaluate patients at moderate risk for ACS. Patients are considered moderate risk if they present with symptoms suspicious for ACS and meet one or more of five inclusion criteria: 1) prior history of ischemic heart disease, 2) 30 years of age or older with

diabetes mellitus, 3) 50 years of age or older with two or more cardiovascular risk factors (CRF), 4) 60 years of age or older with one or more CRF, or 5) no alternate diagnosis more likely than ACS. Patients are observed for at least six hours and repeat electrocardiogram (ECG) and cardiac chemical markers are performed at this time. If both are negative, provocative testing is performed, usually exercise treadmill testing (ETT), to rule out ACS. If repeat ECG or cardiac markers are diagnostic of ACS or the ETT is high risk, patients are admitted to hospital with the diagnosis of ACS. Patients with an alternate diagnosis to explain symptoms or those who do not meet inclusion criteria, that is, low risk for ACS, are not enrolled in the CPP. Conversely, patients who are felt to be high risk for ACS, either because of convincing clinical history or positive ECG and/or cardiac markers, are not enrolled in the CPP but are admitted directly to hospital.

Approximately 40 – 50 patients are enrolled per month in the CPP. For this study, a convenience sample of 100 patients was obtained. The goal was to have sufficient numbers to allow for subgroup analysis. The recruitment phase of the study occurred over a period of ten weeks, from September to November 2002.

Data Collection Procedure

Patients presenting to the ED, and subsequently enrolled in the University of Alberta Hospital CPP, were approached by the CPP ED nurse and the purpose of the study explained to them verbally and using a written information summary (Appendix B). Informed consent was obtained by the CPP ED nurse for those patients willing to participate in the study (Appendix C). Patients who presented at times when the CPP ED nurse was not available were asked by the bedside ED nurse or the ETT laboratory technician for permission to have the researcher approach them. If patients gave

permission, the researcher proceeded to obtain consent. If the patient was discharged before consent was obtained, the researcher called the patient at home to obtain consent.

Once consent was obtained, the researcher, the Nurse Practitioner (NP) for the CPP, then took the patient's history of their presenting symptoms and recorded the information on a data collection tool (Appendix D). The history taken was part of the routine diagnostic assessment for patients presenting to the CPP and did not involve any additional questions or time (approximately 15 minutes). The symptoms described by the patient were recorded on the data collection tool (Appendix D), in addition to the regular CPP history form.

For those patients enrolled in the CPP at night and/or on weekends, the initial history was obtained by the Cardiology Resident on-call. To maintain consistency in symptom assessment and documentation, the history relating to the patient's presenting symptoms was re-obtained by the NP/Researcher the following day or Monday respectively, either in person when the patient returned to the hospital for their scheduled ETT, via the telephone if not returning to hospital, or in-hospital if the patient was admitted from the ED.

When the presenting symptom was pain or discomfort, the location, quality, radiation, and duration of the symptom, aggravating and alleviating factors, activity at onset, as well as associated symptoms were recorded. Then, the symptom presentation was independently categorized by the researcher as typical or atypical, as previously defined. If the presenting symptom was not chest pain, it was classified as atypical and the specific symptom was recorded. Based on the patient's presentation and prior to provocative testing, i.e., ETT, the ED physician's estimate of likelihood of a diagnosis of

diagnosis of ACS (high or low) was recorded if the ED physician was available. The estimate of likelihood of ACS given by the Cardiologist or the NP was also recorded following their initial assessment of the patient and prior to provocative testing.

Data were collected from the health record, including age, laboratory, and other diagnostic test results. Patients were asked about their cardiovascular risk factors. Height and weight, to calculate body mass index (BMI), were documented for each patient. If the patient had sought attention from a health care provider for symptoms similar to the presenting symptoms within 30 days prior to their ED presentation this was noted. Admission to hospital with the diagnosis of UA or NSTEMI, confirmed by the discharge summary was recorded. Patients with positive ETT, MIBI or stress echocardiography (echo) results were considered as having a diagnosis of UA. Patients with inconclusive ETT often underwent subsequent MIBI scan or stress echo, and the results were recorded for these patients; those who did not go on to have MIBI scan or stress echo because they were considered low risk for ACS were given the diagnosis of NACS. Patients discharged from the CPP prior to undergoing provocative testing (ETT or MIBI), because they were deemed low risk by the Cardiology team based on clinical history, were also given the diagnosis of NACS.

Data Analysis

Data were coded and entered into the Statistical Package for the Social Sciences (SPSS) software package version 11.0. Descriptive statistics, including means, medians, percentages, ranges, and standard deviations, were employed to describe characteristics of the sample. Descriptive statistics were also used to describe the incidence of typical and atypical presentations in ACS and NACS, as well as the frequency of presenting symptoms. Percentage agreement, between the researcher and

thesis supervisor, on categorization of typical and atypical presentation was calculated on a random sample of 28 patients (28%).

Chi-square analysis was used to examine the differences between patients presenting typically and atypically, and between those with ACS and NACS, in the following variables: age, gender, BMI, ethnicity, chief complaint and other symptom characteristics, cardiovascular risk factors, history of ischemic heart disease, prior health care seeking behavior, diagnostic findings, and NP impression of likelihood of ACS. All variables were grouped into categorical data: < 65 years, ≥ 65 years; male, female; BMI ≤ 27, > 27; Caucasian yes, no; diabetes mellitus yes, no; hyperlipidemia yes, no; hypertension yes, no; positive family history yes, no; smoker yes, no; prior IHD yes, no; chest pain yes, no; symptom characteristics (e.g., location, quality, associated symptoms, etc.) yes, no; prior health-seeking behavior yes, no; diagnostic findings positive, negative; NP likelihood of ACS high, low. The significance level was set at $p \leq 0.05$.

Ethical Considerations

Ethical approval for this study was obtained from the Health Ethics Review Board, Capital Health Region. Patients meeting the sample inclusion criteria were approached by the researcher and informed of the purpose of the study (Appendix B). Interested patients signed an informed consent (Appendix C), a copy of which was retained by the patient. If patients were contacted via telephone for participation in the study, telephone consent was obtained and recorded, and a written consent form and information sheet was mailed to the patient's home.

There were no identified direct risks or benefits for patients participating in this study; however, information gained will potentially contribute to the understanding of

ACS. Patients were free to refuse to participate or answer any questions, and were free to withdraw from the study at any time, by notifying the researcher, with no consequence to their care. Confidentiality of the participants was maintained and no names appear on the data collected. Code numbers were used to identify all data. All data were stored in a locked and secured cabinet.

CHAPTER FOUR

Findings

The purpose of this study was to compare typical and atypical presentations in the diagnosis of acute coronary syndromes (ACS) versus no ACS (NACS) among patients presenting to the Emergency Department (ED) based Chest Pain Program (CPP) at the University of Alberta Hospital. A prospective, cohort design was used to examine the relationship between symptom presentation and the diagnosis of ACS, cardiovascular risk factors, history of ischemic heart disease, prior health care seeking behavior, and diagnostic findings. Data were analyzed using descriptive statistics and chi-square tests.

Description of the Sample

All patients enrolled in the University of Alberta Hospital CPP, during the ten-week study period (September to November 2002), were approached by the researcher. Of the 149 patients enrolled in the CPP, 49 patients did not participate either due to predetermined study exclusion criteria (n = 16) or for other reasons (n = 33) as described in Table 1, leaving a convenience sample of 100 patients who consented to participate in the study. Demographics, cardiovascular risk factors, past history of ischemic heart disease, as well as a detailed symptom history were obtained for each patient by taking the patient's history. Diagnostic investigation results and final diagnosis were also recorded from the patient's health record.

Table 1

Reason and Number of Patients Excluded from Study

Reason for Exclusion	*N*
Confusion/dementia	3
Discharge against medical advice	4
Enrolled in CPP more than once	1
No show/refused testing	2
Refused to participate	6
Transferred to another hospital prior to enrollment	7
Unable to communicate (prior gun shot wound to face)	1
Unable to reach via telephone	19
Unable to speak/understand English	6
TOTAL	49

The sample was nearly equally split between males (n = 52, 52%) and females (n = 48, 48%) (Table 2). The age of the patients ranged from 34 to 95 years with a mean of 61.42 years (SD = 13.50); 59% of the patients were less than 65 years of age. Obesity was documented in the majority of patients (n = 60, 60%). The patients were predominantly Caucasian (n = 86, 86%).

Table 2

Symptom Presentation – Characteristics of the Sample

Demographic	Frequency (%)	Presentation		*p* value
		Typical	Atypical	
Age				
< 65 years	59 (59%)	7	52	0.561
≥ 65 years	41 (41%)	7	34	
Gender				
Male	52 (52%)	8	44	0.678
Female	48 (48%)	6	42	
BMI				
≤ 27	40 (40%)	6	34	0.814
> 27	60 (60%)	8	52	
Ethnicity				
Caucasian	86 (86%)	14	72	0.208
Non-Caucasian	14 (14%)	0	14	
African	2 (2%)	0	2	
Asian	4 (4%)	0	4	
South Asian	4 (4%)	0	4	
Other	4 (4%)	0	4	

Table 2a

Final Diagnosis – Characteristics of the Sample

Demographic	Frequency (%)	Final Diagnosis ACS	Final Diagnosis NACS	*p* value
Age				
< 65 years	59 (59%)	18	41	1.000
≥ 65 years	41 (41%)	13	28	
Gender				
Male	52 (52%)	21	31	**0.035**
Female	48 (48%)	10	38	
BMI				
≤ 27	40 (40%)	14	26	0.480
> 27	60 (60%)	17	43	
Ethnicity				
Caucasian	86 (86%)	28	58	0.540
Non-Caucasian	14 (14%)	3	11	
African	2 (2%)	0	2	
Asian	4 (4%)	0	4	
South Asian	4 (4%)	2	2	
Other	4 (4%)	1	3	

Symptom Presentation

Presenting symptoms were examined in detail to answer the following questions. First, what was the incidence of typical versus atypical symptoms in individuals with ACS and NACS? Second, what was the relationship of symptom presentation to the diagnosis of ACS and NACS? Finally, what was the presenting symptom or chief complaint, as well as the symptom characteristics including, location, quality, radiation, aggravating and alleviating factors, associated symptoms, additional features and duration of symptoms, when subjects presented atypically?

The patients were categorized into two groups, typical and atypical presentation, based on the preset study definition. To ensure adherence to this definition the researcher and thesis supervisor independently categorized a random sample (n = 28) from the study. There was agreement on 20 of the 28 patients reviewed, for a percentage agreement of 71.4%. There was disagreement on eight of the cases due to location (n = 4), quality (n = 1), and associated symptoms or other features; i.e., increase on palpation (n = 3). Consensus was achieved with five of eight assigned the researcher's categorization and three assigned the thesis supervisor's categorization.

Incidence of Typical and Atypical Presentation

For the purpose of this study, typical presentation was defined as substernal or retrosternal pain or discomfort (may radiate to neck, jaw, epigastrium, or arms), with a characteristic quality (squeezing, pressurelike, heavy), that may be reproducible by physical exertion or emotional stress, and usually relieved with rest or nitroglycerine (Gibbons et al., 1999); chest pain may have occurred at rest (Braunwald et al., 2000). If a symptom was typical, for instance, in location, but other features were atypical by definition, i.e., quality, it was coded as an atypical presentation. Table 3 illustrates the incidence of typical and atypical presentations. Only fourteen patients (14%) met the predetermined study criteria for typical presentation, while the majority, 86 (86%), presented atypically.

Eight males (57.1%) and six (42.9%) females had typical presentations (Table 2). No significant relationship was found between gender and presentation (χ^2 [1, N = 100] = 0.173, p = 0.678). The same number (n = 7, 50%) of patients under the age of 65 years as over had typical presentations; no significant difference was found

(χ^2 [1, N = 100] = 0.545, p = 0.561). A similar percentage of obese (n = 8, 57.1%) and non-obese (n = 6, 42.9%) patients had typical presentations. Consequently, there were no significant differences between these groups for symptom presentation (χ^2 [1, N = 100] = 0.055, p = 0.814). Fourteen (100%) of the 86 Caucasian patients had typical presentations versus none of the 14 non-Caucasians; however, no significant differences for symptom presentation and ethnicity were found (χ^2 [1, N = 100] = 1.470, p = 0.208).

Symptom Presentation and Acute Coronary Syndromes

Two-thirds of the 31 patients with a final diagnosis of ACS (n = 21, 67.7%) were male, while one-third (n = 10, 32.3%) were female. A significantly higher proportion of males than females had a final diagnosis of ACS (χ^2 [1, N = 100] = 4.461, p = 0.035) as demonstrated in Table 2a. More men (n = 16/21, 76.2%) than women (n = 7/10, 70%) with ACS had an atypical presentation; however, this was not statistically significant (χ^2 [1, N = 31] = 0.000, p = 1.000).

Eighteen of the 31 patients (58.1%) with a final diagnosis of ACS were under the age of 65 years, whereas 13 of the 31 patients (41.9%) with ACS were 65 years of age and older (Table 2a). No significant difference was found between age and final diagnosis (χ^2 [1, N = 100] = 0.016, p = 1.000). A higher percentage of younger patients (n = 14/18, 77.8%) than older patients (n = 9/13, 69.2%) had both an atypical presentation and a final diagnosis of ACS. However, this was not statistically significant (χ^2 [1, N = 31] = 0.015, p = 0.689).

The numbers are similar for final diagnosis of ACS in obese (n = 17, 54.8%) and non-obese (n = 14, 45.2%) patients (Table 2a). There was no significant difference between obesity and final diagnosis (χ^2 [1, N = 100] = 0.499, p = 0.480). Three (9.7%)

non-Caucasian patients had a final diagnosis of ACS, while the majority of patients with a final diagnosis of ACS were Caucasian (90.3%). Of the 3 non-Caucasian patients with ACS, all had atypical presentations (χ^2 [1, N = 100] = 0.274, p = 0.540).

Only 25.8% (n = 8/31) of patients with a final diagnosis of ACS had typical presentations, whereas the majority, 74.2% (n = 23/31) presented atypically (Table 3). Conversely, of the 14 patients in total with typical presentations, 8 (57.1%) had a final diagnosis of ACS, while the remaining 6 patients with typical presentations (42.9%) had NACS. Patients with typical presentations were more likely to have ACS than NACS (χ^2 [1, N = 100] = 3.877, p = 0.031). Figure1 further illustrates the incidence of typical and atypical symptom presentations according to diagnosis. Of the 31 patients with a diagnosis of ACS, 23 had unstable angina (UA) and 8 had non-ST elevation myocardial infarction (NSTEMI). These numbers were insufficient to analyze separately.

Table 3

Symptom Presentation and Final Diagnosis

Symptom Presentation	Frequency (%)	Final Diagnosis		*p* value
		ACS	NACS	
Typical Presentation	14 (14%)	8	6	**0.031**
Atypical Presentation	86 (86%)	23	63	

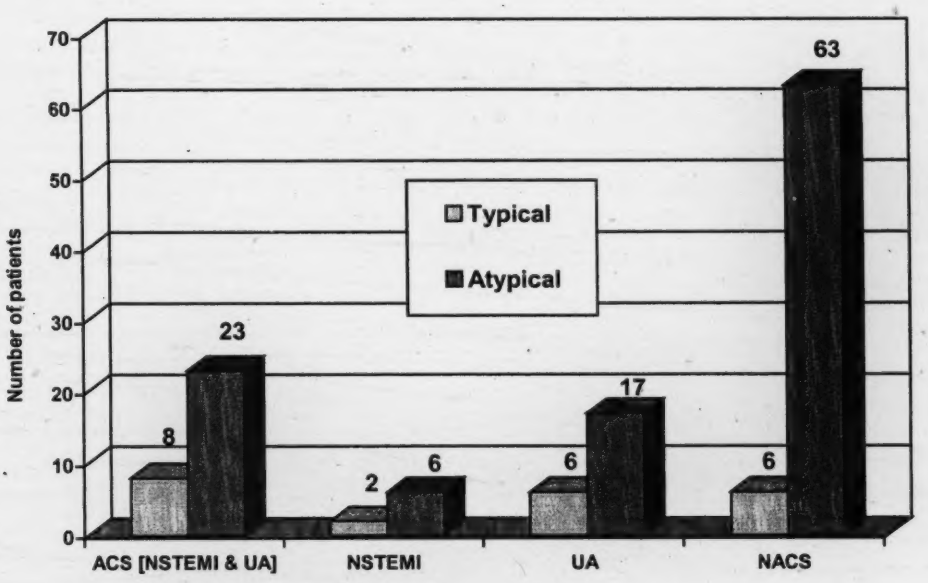

Figure 1. Symptom presentation and final diagnosis.

Symptom Presentation and Chief Complaints

Although 78% (n = 78) of the sample had chest pain as their primary symptom or chief complaint, most did not meet study criteria for typical presentation (Table 4). Only 14 of these 78 (17.9%) patients with 'chest pain only' met criteria for typical presentation, yet 25 of 78 (32%) had ACS (Table 4a). There was a significant difference between symptom presentation and the chief complaint of 'chest pain only'; 100% of patients with typical presentation had a chief complaint of 'chest pain only', whereas 74.4% of patients with atypical presentation had 'chest pain only' (χ^2 [1, N = 100] = 3.222, p = 0.035).

Most of the patients who presented atypically had chest pain (n = 64, 64%) that had one or more atypical features. A small number (n = 7, 7%) had chest pain combined with a second chief complaint, usually shortness of breath (n = 4) (Table 4). Two of these seven patients had a final diagnosis of ACS (Table 4a). The remaining patients

who presented atypically (n = 15, 15%) had a symptom other than chest pain, most commonly epigastric/abdominal pain (n = 4). Four of these 15 patients were diagnosed with ACS. There were no significant differences between 'other symptom only' (χ^2 [1, N = 100] = 1.668, p = 0.120) or 'chest pain and other symptom' (χ^2 [1, N = 100] = 0.294, p = 0.589) and presentation (Table 4), nor between final diagnosis and chief complaint (Table 4a).

Table 4

Symptom Presentation – Chief Complaint

Chief Complaint	Frequency (%)	Presentation		*p* value
		Typical	Atypical	
Chest pain only				
Yes	78 (78%)	14	64	**0.035**
No	22 (22%)	0	22	
Other symptom only				
Yes	15 (15%)	0	15	0.121
No	85 (85%)	14	71	
Back/between scapula pain	3 (3%)	0	3	
Chin/lips/neck numbness	1 (1%)	0	1	
Dizziness	2 (2%)	0	2	
Epigastric/abdominal	4 (4%)	0	4	
Jaw pain	1 (1%)	0	1	
Left arm pain	2 (2%)	0	2	
Left shoulder/arm pain	1 (1%)	0	1	
Left shoulder/neck pain	1 (1%)	0	1	
Chest pain and other symptom				
Yes	7 (7%)	0	7	0.589
No	93 (93%)	14	79	
Chest and epigastric pain	1 (1%)	0	1	
Chest pain and dizziness	1 (1%)	0	1	
Chest and left shoulder pain	1 (1%)	0	1	
Chest pain and shortness of breath	4 (4%)	0	4	

Table 4a

Final Diagnosis – Chief Complaint

Chief Complaint	Frequency (%)	Final Diagnosis		*p* value
		ACS	NACS	
Chest pain only				
Yes	78 (78%)	25	53	0.669
No	22 (22%)	6	16	
Other symptom only				
Yes	15 (15%)	4	11	0.772
No	85 (85%)	27	58	
Back/between scapula pain	3 (3%)	1	2	
Chin/lips/neck numbness	1 (1%)	1	0	
Dizziness	2 (2%)	0	2	
Epigastric/abdominal	4 (4%)	0	4	
Jaw pain	1 (1%)	0	1	
Left arm pain	2 (2%)	1	1	
Left shoulder/arm pain	1 (1%)	0	1	
Left shoulder/neck pain	1 (1%)	1	0	
Chest pain and other symptom				
Yes	7 (7%)	2	5	1.000
No	93 (93%)	29	64	
Chest and epigastric pain	1 (1%)	0	1	
Chest pain and dizziness	1 (1%)	0	1	
Chest and left shoulder pain	1 (1%)	0	1	
Chest pain and shortness of breath	4 (4%)	2	2	

The following Figures further summarize the chief complaints for both typical and atypical presentations (Figure 2), and ACS and NACS (Figure 3).

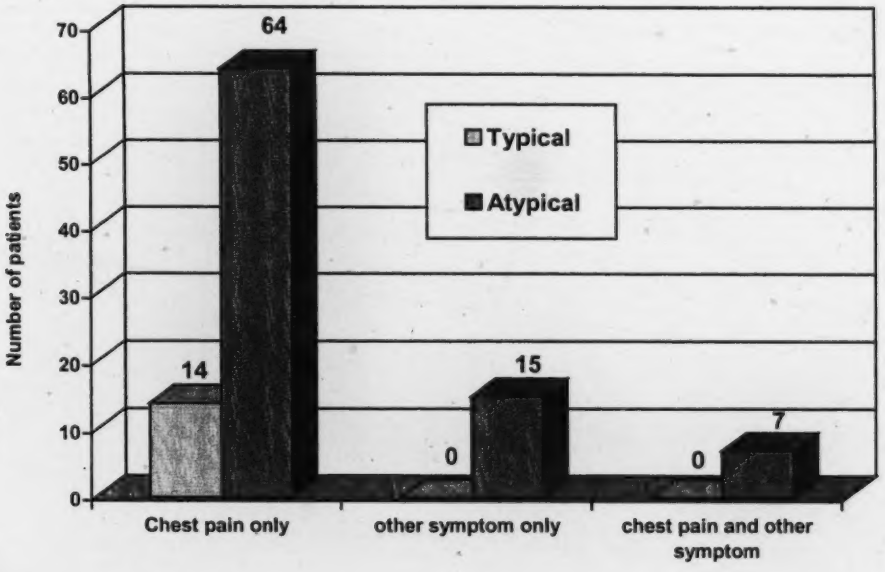

Figure 2. Symptom presentation and chief complaint.

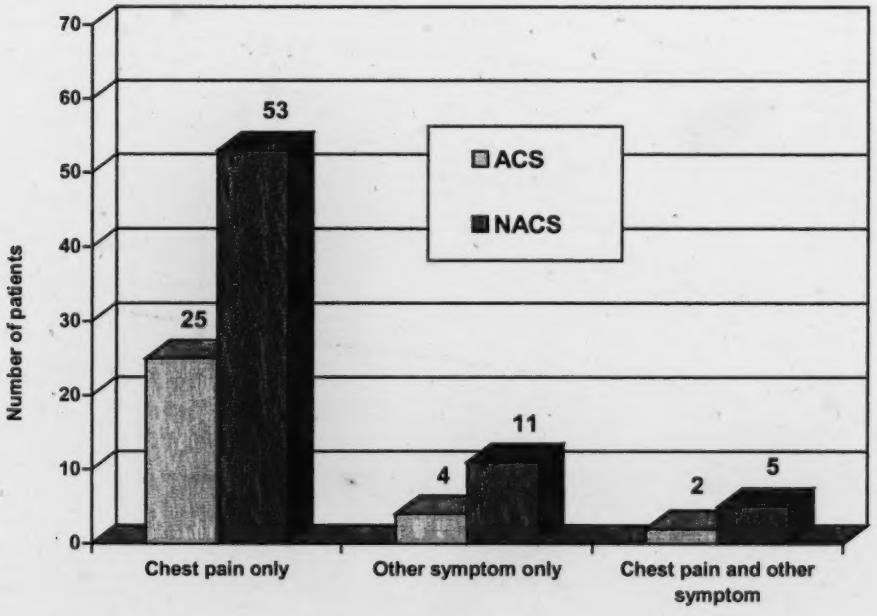

Figure 3. Final diagnosis and chief complaint.

A detailed analysis of the characteristics of the chief complaint was undertaken to determine if any significant differences exist between patients who presented typically and atypically, and also between patients with ACS and NACS. These characteristics included location, quality, radiation, aggravating and alleviating factors, associated symptoms, additional features and duration of symptoms. One patient's symptom complex may encompass more than one location, quality, associated symptom, etc. Therefore, if the same person had both a typical and atypical location, for example, it was classified as atypical location when the variable was grouped together.

Location. The most frequent location, and also the only location considered typical by definition, was mid/sub/retrosternal, with a frequency of 39% (n = 39); however, 25 of these 39 (64.1%) were coded as atypical presentations because of other coexisting atypical features. Overall, there was a statistically significant difference found between location and symptom presentation; patients with typical locations tended to have typical presentations (χ^2 [1, N = 100] = 27.718, $p < 0.001$) (Table 5). Specifically, the typical presentation group had a significantly higher incidence of mid/sub/retrosternal location (χ^2 [1, N = 100] = 25.462, $p < 0.001$). Whereas, the atypical presentation group had a significantly higher rate of left middle chest location (χ^2 [1, N = 100] = 4.216, p = 0.018). Nearly one-half of the patients with ACS had atypical locations (n = 15, 48.4%). Overall, a significantly higher proportion of patients with ACS versus NACS had typical locations (χ^2 [1, N = 100] = 4.116, p = 0.042) (Table 5a).

Table 5

Symptom Presentation – Location

Location	Frequency (%)*	Presentation		*p* value
		Typical	Atypical	
Mid/sub/retrosternal[1]				
Yes	39 (39%)	14	25	**< 0.001**
No	61 (61%)	0	61	
Left middle chest[2]				
Yes	26 (26%)	0	26	**0.018**
No	74 (74%)	14	60	
Left upper chest[2]				
Yes	4 (4%)	0	4	1.000
No	96 (96%)	14	82	
Left lower chest[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Left axilla[2]				
Yes	4 (4%)	0	4	1.000
No	96 (96%)	14	82	
Right chest[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	14	85	
Chest both sides[2]				
Yes	12 (12%)	0	12	0.208
No	88 (88%)	14	74	
Left arm[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Left shoulder[2]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	14	84	
Neck/Jaw[2]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	14	84	
Epigastric/abdominal[2]				
Yes	7 (7%)	0	7	0.589
No	93 (93%)	14	79	
Between scapula[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Xiphoid[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Typical location	37 (37%)	14	23	**< 0.001**
Atypical location	63 (63%)	0	63	

*Some patients used more than one term to describe location. If a subject used both typical and atypical locations it was coded as atypical location.

[1]Typical location [2]Atypical location

Table 5a

Final Diagnosis – Location

Location	Frequency (%)*	Final Diagnosis		*p* value
		ACS	NACS	
Mid/sub/retrosternal[1]				
Yes	39 (39%)	16	23	0.083
No	61 (61%)	15	46	
Left middle chest[2]				
Yes	26 (26%)	6	20	0.310
No	74 (74%)	25	49	
Left upper chest[2]				
Yes	4 (4%)	0	4	0.308
No	96 (96%)	31	65	
Left lower chest[2]				
Yes	3 (3%)	1	2	1.000
No	97 (97%)	30	67	
Left axilla[2]				
Yes	4 (4%)	0	4	0.308
No	96 (96%)	31	65	
Right chest[2]				
Yes	1 (1%)	1	0	0.310
No	99 (99%)	30	69	
Chest both sides[2]				
Yes	12 (12%)	4	8	1.000
No	88 (88%)	27	61	
Left arm[2]				
Yes	3 (3%)	1	2	1.000
No	97 (97%)	30	67	
Left shoulder[2]				
Yes	2 (2%)	1	1	0.526
No	98 (98%)	30	68	
Neck/jaw[2]				
Yes	2 (2%)	1	1	0.526
No	98 (98%)	30	68	
Epigastric/abdominal[2]				
Yes	7 (7%)	1	6	0.431
No	93 (93%)	30	63	
Between scapula[2]				
Yes	3 (3%)	1	2	1.000
No	97 (97%)	30	67	
Xiphoid[2]				
Yes	3 (3%)	1	2	1.000
No	97 (97%)	30	67	
Typical location	37 (37%)	16	21	**0.042**
Atypical location	63 (63%)	15	48	

*Some patients used more than one term to describe location. If a subject used both typical and atypical locations it was coded as atypical location.
[1]Typical location [2]Atypical location

Quality. The second symptom characteristic to be analyzed was quality. Table 6 lists specific typical and atypical qualities, as well as an overall grouping in the final section, and compares each with symptom presentation. Table 6a does the same but compares quality with final diagnosis. The qualities seen most frequently were those considered typical of discomfort of cardiac origin, including tightness (n = 18, 18%), heaviness (n = 17, 17%), and pressure (n = 23, 23%) (Table 6). However, sharp, an atypical quality, occurred as frequently (n = 21, 21%). Overall, when qualities were grouped according to typical or atypical and then compared with symptom presentation, a significantly higher proportion of patients with typical qualities had typical versus atypical presentations (χ^2 [1, N = 100] = 17.636, $p < 0.001$), including those with the quality of pressure (χ^2 [1, N = 100] = 5.045, p = 0.016). As well, patients were significantly more likely to have an atypical presentation if their symptoms were sharp in quality (χ^2 [1, N = 100] = 2.981, p = 0.037).

Of the 31 patients who had a final diagnosis of ACS, just as many patients with a final diagnosis of ACS had sharp chest pain (n = 6), as had ACS and tightness (n = 6), heaviness (n = 6), or pressure (n = 5) (Table 6a). A diagnosis of ACS was seen among patients with other atypical qualities including, stabbing/jabbing (n = 1), burning (n = 2), pinching (n = 1), raw meat (n = 1), and throbbing (n = 1). Nearly equal numbers of patients had ACS in both the typical (n = 15, 48.4%) and atypical (n = 16, 51.6%) quality groups (χ^2 [1, N = 100] = 0.003, p = 0.959).

Table 6
Symptom Presentation – Quality

Quality	Frequency (%)*	Presentation		*p* value
		Typical	Atypical	
Tightness[1]				
Yes	18 (18%)	2	16	1.000
No	82 (82%)	12	70	
Heaviness[1]				
Yes	17 (17%)	5	12	0.059
No	83 (83%)	9	74	
Pressure[1]				
Yes	23 (23%)	7	16	**0.016**
No	77 (77%)	7	70	
Sharp[2]				
Yes	21 (21%)	0	21	**0.037**
No	79 (79%)	14	65	
Dull[1]				
Yes	10 (10%)	2	8	0.628
No	90 (90%)	12	78	
Ache[1]				
Yes	11 (11%)	2	9	0.650
No	89 (89%)	12	77	
Stabbing/jabbing[2]				
Yes	5 (5%)	0	5	1.000
No	95 (95%)	14	81	
Burning[2]				
Yes	7 (7%)	0	7	0.589
No	93 (93%)	14	79	
Pinching[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	14	85	
Squeezing[1]				
Yes	8 (8%)	1	7	1.000
No	92 (92%)	13	79	
Raw meat[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	14	85	
Cramping[2]				
Yes	4 (4%)	0	4	1.000
No	96 (96%)	14	82	
Crushing[1]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Belt[1]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	14	84	
Throbbing[2]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	14	84	
Typical quality	48 (48%)	14	34	**< 0.001**
Atypical quality	52 (52%)	0	52	

*Some patients used more than one term to describe quality. If a subject used both typical and atypical quality descriptors it was coded as atypical quality.
[1]Typical quality [2]Atypical quality

Table 6a
Final Diagnosis – Quality

Quality	Frequency (%)*	Final Diagnosis		*p* value
		ACS	NACS	
Tightness[1]				
Yes	18 (18%)	6	12	0.813
No	82 (82%)	25	57	
Heaviness[1]				
Yes	17 (17%)	6	11	0.674
No	83 (83%)	25	58	
Pressure[1]				
Yes	23 (23%)	5	18	0.274
No	77 (77%)	26	51	
Sharp[2]				
Yes	21 (21%)	6	15	0.787
No	79 (79%)	25	54	
Dull[1]				
Yes	10 (10%)	6	4	0.066
No	90 (90%)	25	65	
Ache[1]				
Yes	11 (11%)	4	7	0.735
No	89 (89%)	27	62	
Stabbing/jabbing[2]				
Yes	5 (5%)	1	4	1.000
No	95 (95%)	30	65	
Burning[2]				
Yes	7 (7%)	2	5	1.000
No	93 (93%)	29	64	
Pinching[2]				
Yes	1 (1%)	1	0	0.310
No	99 (99%)	30	69	
Squeezing[1]				
Yes	8 (8%)	0	8	0.055
No	92 (92%)	31	61	
Raw meat[2]				
Yes	1 (1%)	1	0	0.310
No	99 (99%)	30	69	
Cramping[2]				
Yes	4 (4%)	0	4	0.308
No	96 (96%)	31	65	
Crushing[1]				
Yes	3 (3%)	0	3	0.550
No	97 (97%)	31	66	
Belt[1]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	31	67	
Throbbing[2]				
Yes	2 (2%)	1	1	0.526
No	98 (98%)	30	68	
Typical quality	48 (48%)	15	33	0.959
Atypical quality	52 (52%)	16	36	

*Some patients used more than one term to describe quality. If a subject used both typical and atypical quality descriptors it was coded as atypical quality.
[1]Typical quality [2]Atypical quality

Radiation. The characteristic of radiation was classified as typical if pain radiated to the arms, jaw, neck or epigastrium, or if there was no radiation of symptoms. The three most frequent sites of radiation were the left arm (n = 26), neck, throat, or jaw (n = 23), both considered typical, and the back or scapula (n = 16) categorized as atypical (Table 7). There was no radiation in 21 (21%) cases. Despite the fact that 83 patients had typical radiation, the vast majority (n = 69) had atypical presentations due to other concurrent, atypical features. Twenty-seven of the 31 patients (87.1%) with a final diagnosis of ACS had typical radiation of symptoms, whereas only 4 patients (12.9%) with ACS had atypical radiation (Table 7a). Neither symptom presentation (χ^2 [1, N = 100] = 2.080, p = 0.119) nor final diagnosis (χ^2 [1, N = 100] = 0.534, p = 0.465) had a significant relationship to radiation.

Table 7

Symptom Presentation – Radiation

Radiation	Frequency (%)*	Presentation		*p* value
		Typical	Atypical	
Neck/throat/jaw[1]				
Yes	23 (23%)	2	21	0.512
No	77 (77%)	12	65	
Left arm[1]				
Yes	26 (26%)	2	24	0.346
No	74 (74%)	12	62	
Right arm[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Both arms[1]				
Yes	9 (9%)	2	7	0.609
No	91 (91%)	12	79	
Left/both shoulders[1]				
Yes	12 (12%)	1	11	1.000
No	88 (88%)	13	75	
Mouth[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	14	85	
Back/scapula[2]				
Yes	16 (16%)	0	16	0.117
No	84 (84%)	14	70	
Epigastrium/abdomen[1]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	14	84	
Legs[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	14	85	
Left chest[1]				
Yes	8 (8%)	1	7	1.000
No	92 (92%)	13	79	
Right chest[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	14	85	
Both sides chest[1]				
Yes	8 (8%)	1	7	1.000
No	92 (92%)	13	79	
Mid chest[2]				
Yes	7 (7%)	0	7	0.589
No	93 (93%)	14	79	
No radiation[1]				
Yes	21 (21%)	5	16	0.164
No	79 (79%)	9	70	
Typical radiation	83 (83%)	14	69	0.119
Atypical radiation	17 (17%)	0	17	

*Some patients used more than one term to describe radiation. If pain radiated to both typical and atypical locations it was coded as atypical radiation.
[1]Typical radiation [2]Atypical radiation

Table 7a

Final Diagnosis – Radiation

Radiation	Frequency (%)*	Final Diagnosis		*p* value
		ACS	NACS	
Neck/throat/jaw[1]				
Yes	23 (23%)	5	18	0.274
No	77 (77%)	26	51	
Left arm[1]				
Yes	26 (26%)	7	19	0.601
No	74 (74%)	24	50	
Right arm[2]				
Yes	3 (3%)	1	2	1.000
No	97 (97%)	30	67	
Both arms[1]				
Yes	9 (9%)	5	4	0.131
No	91 (91%)	26	65	
Left/both shoulders[1]				
Yes	12 (12%)	3	9	0.750
No	88 (88%)	28	60	
Mouth[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	31	68	
Back/scapula[2]				
Yes	16 (16%)	3	13	0.378
No	84 (84%)	28	56	
Epigastrium/abdomen[1]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	31	67	
Legs[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	31	68	
Left chest[1]				
Yes	8 (8%)	1	7	0.429
No	92 (92%)	30	62	
Right chest[2]				
Yes	1 (1%)	1	0	0.310
No	99 (99%)	30	69	
Both sides chest[1]				
Yes	8 (8%)	3	5	0.700
No	92 (92%)	28	64	
Mid chest[2]				
Yes	7 (7%)	2	5	1.000
No	93 (93%)	29	64	
No radiation[1]				
Yes	21 (21%)	6	15	0.787
No	79 (79%)	25	54	
Typical radiation	83 (83%)	27	56	0.465
Atypical radiation	17 (17%)	4	13	

*Some patients used more than one term to describe radiation. If pain radiated to both typical and atypical locations it was coded as atypical radiation.
[1]Typical radiation [2]Atypical radiation

Aggravating factors. Fifty-two percent of patients (n = 52) had factors that aggravated their symptoms. Only one factor, physical exertion/emotional stress, was considered typical. When there were no aggravating factors, it was also regarded as typical. As shown in Table 8, these two occurrences had the highest frequencies, occurring 24% and 48% of the time, respectively. The most frequent atypical aggravating factor was breathing (n = 14), followed closely by recumbent/supine position (n = 10), change of position (n = 9), and palpation at the site of pain (n = 8). A few of the patients with atypical aggravating factors were coded as typical presentation because, while exertion and emotional stress are thought to reproduce cardiac discomfort, the other aggravating factors were not excluded by definition.

Just under one-half of the 24 patients whose symptoms were aggravated by exertion or emotional stress had ACS (n = 11), but more did not (n = 13) (Table 8a). An equal number of patients with the atypical aggravating factor of recumbent/lying supine had ACS or NACS (n = 5). The relationship of typical and atypical aggravating factors to typical and atypical symptom presentation was not significant (χ^2 [1, N = 100] = 1.890, p = 0.130). Nor was a significant difference found between aggravating factors and final diagnosis (χ^2 [1, N = 100] = 0.494, p = 0.482).

Table 8

Symptom Presentation – Aggravating Factors

Aggravating Factors	Frequency (%)*	Presentation		*p* value
		Typical	Atypical	
Exertion/stress[1]				
Yes	24 (24%)	4	20	0.738
No	76 (76%)	10	66	
Position change[2]				
Yes	9 (9%)	0	9	0.352
No	91 (91%)	14	77	
Breathing[2]				
Yes	14 (14%)	0	14	0.208
No	86 (86%)	14	72	
Palpation[2]				
Yes	8 (8%)	1	7	1.000
No	92 (92%)	13	79	
Recumbent/supine[2]				
Yes	10 (10%)	1	9	1.000
No	90 (90%)	13	77	
Bending over[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
No aggravating factors[1]				
Yes	48 (48%)	8	40	0.460
No	52 (52%)	6	46	
Typical aggravating factors	66 (66%)	12	54	0.130
Atypical aggravating factors	34 (34%)	2	32	

*Some patients used more than one term as aggravating. If pain had both typical and atypical aggravating factors it was coded as an atypical aggravating factor.
[1]Typical aggravating factor [2]Atypical aggravating factor

Table 8a

Final Diagnosis – Aggravating Factors

Aggravating Factors	Frequency (%)*	Final Diagnosis		*p* value
		ACS	NACS	
Exertion/stress[1]				
Yes	24 (24%)	11	13	0.071
No	76 (76%)	20	56	
Position change[2]				
Yes	9 (9%)	1	8	0.267
No	91 (91%)	30	61	
Breathing[2]				
Yes	14 (14%)	2	12	0.215
No	86 (86%)	29	57	
Palpation[2]				
Yes	8 (8%)	1	7	0.429
No	92 (92%)	30	62	
Recumbent/supine[2]				
Yes	10 (10%)	5	5	0.277
No	90 (90%)	26	64	
Bending over[2]				
Yes	3 (3%)	0	3	0.550
No	97 (97%)	31	66	
No aggravating factors[1]				
Yes	48 (48%)	12	36	0.213
No	52 (52%)	19	33	
Typical aggravating factors	66 (66%)	22	44	0.482
Atypical aggravating factors	34 (34%)	9	25	

*Some patients used more than one term as aggravating. If pain had both typical and atypical aggravating factors it was coded as an atypical aggravating factor.
[1]Typical aggravating factor [2]Atypical aggravating factor

Alleviating factors. Table 9 lists individual typical and atypical alleviating factors, as well as, an overall grouping in the final section, and compares each to symptom presentation. Table 9a does the same but compares alleviating factors to final diagnosis. The most common typical alleviating factor was nitroglycerine (*n* = 47), defined as partial or complete relief of symptoms within five to ten minutes of taking the drug. Next most common were rest (*n* = 37) and oxygen (*n* = 18). Analgesic/anti-inflammatory (*n* = 18) and position change (*n* = 10) were the most frequent atypical alleviating factors. Patients with typical presentations were significantly more likely to have typical alleviating factors

than patients with atypical presentations (χ^2 [1, N = 100] = 3.957, p = 0.047). Of the 31 patients with ACS, 20 (64.5%) had typical alleviating factors, while 11 (35.5%) experienced atypical alleviating factors. The relationship between alleviating factors and final diagnosis was not significant (χ^2 [1, N = 100] = 2.000, p = 0.157).

Table 9

Symptom Presentation – Alleviating Factors

Alleviating Factors	Frequency (%)*	Presentation		*p* value
		Typical	Atypical	
Rest[1]				
Yes	37 (37%)	7	30	0.277
No	63 (63%)	7	56	
Position change[2]				
Yes	10 (10%)	1	9	1.000
No	90 (90%)	13	77	
Breathing[2]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	14	84	
Antiemetic[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	14	85	
Oxygen[1]				
Yes	18 (18%)	4	14	0.273
No	82 (82%)	10	72	
Movement/exertion[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Eructation/flatulence[2]				
Yes	3 (3%)	0	3	1.000
No	97 (97%)	14	83	
Analgesic/antiinflammatory[2]				
Yes	18 (18%)	1	17	0.455
No	82 (82%)	13	69	
Nitroglycerine[1]				
Yes	47 (47%)	9	38	0.162
No	53 (53%)	5	48	
No alleviating factors[1]				
Yes	12 (12%)	2	10	0.674
No	88 (88%)	12	76	
Typical alleviating factors	54 (54%)	11	43	**0.047**
Atypical alleviating factors	46 (46%)	3	43	

*Some patients used more than one term as alleviating. If pain had both typical and atypical alleviating factors, it was coded as an atypical alleviating factor.
[1]Typical alleviating factor [2]Atypical alleviating factor

Table 9a

Final Diagnosis – Alleviating Factors

Alleviating Factors	Frequency (%)*	Final Diagnosis ACS	Final Diagnosis NACS	*p* value
Rest[1]				
Yes	37 (37%)	13	24	0.493
No	63 (63%)	18	45	
Position change[2]				
Yes	10 (10%)	3	7	1.000
No	90 (90%)	28	62	
Breathing[2]				
Yes	2 (2%)	0	2	1.000
No	98 (98%)	31	67	
Antiemetic[2]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	31	68	
Oxygen[1]				
Yes	18 (18%)	5	13	0.774
No	82 (82%)	26	56	
Movement/exertion[2]				
Yes	3 (3%)	0	3	0.550
No	97 (97%)	31	66	
Eructation/flatulence[2]				
Yes	3 (3%)	1	2	1.000
No	97 (97%)	30	67	
Analgesic/antiinflammatory[2]				
Yes	18 (18%)	5	13	0.744
No	82 (82%)	26	56	
Nitroglycerine[1]				
Yes	47 (47%)	18	29	0.137
No	53 (53%)	13	40	
No alleviating factors[1]				
Yes	12 (12%)	5	7	0.507
No	88 (88%)	26	62	
Typical alleviating factors	54 (54%)	20	34	0.157
Atypical alleviating factors	46 (46%)	11	35	

*Some patients used more than one term as alleviating. If pain had both typical and atypical alleviating factors, it was coded as an atypical alleviating factor.

[1]Typical alleviating factor [2]Atypical alleviating factor

Associated symptoms. Associated symptoms were not included in the study definition for typical/atypical presentation. All associated symptoms were coded as typical, except for 'other'. Other associated symptoms included those symptoms encountered infrequently and not generally thought to be associated with cardiac pain, such as headache, cough, visual disturbance, etc. The most frequent associated symptom was shortness of breath (n = 54) (Table 10). Thirteen of 14 (92.9%) patients with typical presentation had typical associated symptoms versus 77 of 86 (89.5%) with atypical presentation and typical associated symptoms; this difference was not statistically significant (χ^2 [1, N = 100] = 0.000, p = 1.000). Of the 31 patients with a diagnosis of ACS, 26 (83.9%) had typical associated symptoms, while only 5 (16.1%) had atypical associated symptoms including headache (n = 1), hot feeling (n = 1), midsternal burning (n = 1), left leg numbness (n = 1), and pounding in the head (n = 1) (Table 10a). No significant relationship was found between associated symptoms and final diagnosis (χ^2 [1, N = 100] = 1.875, p = 0.277).

Table 10

Symptom Presentation – Associated Symptoms

Associated Symptoms	Frequency (%)*	Presentation		*p* value
		Typical	Atypical	
Shortness of breath[1]				
Yes	54 (54%)	6	48	0.367
No	46 (46%)	8	38	
Diaphoresis[1]				
Yes	43 (43%)	4	39	0.240
No	57 (57%)	10	47	
Syncope[1]				
Yes	1 (1%)	1	0	0.140
No	99 (99%)	13	86	
Presyncope[1]				
Yes	44 (44%)	8	36	0.285
No	56 (56%)	6	50	
Nausea/vomiting[1]				
Yes	36 (36%)	5	31	0.981
No	64 (64%)	9	55	
Palpitations[1]				
Yes	21 (21%)	2	19	0.728
No	79 (79%)	12	67	
Fatigue/weakness[1]				
Yes	11 (11%)	2	9	0.650
No	89 (89%)	12	77	
Other[2]				
Yes	21 (21%)	2	19	0.728
No	79 (79%)	12	67	
No associated symptoms[1]				
Yes	12 (12%)	2	10	0.674
No	88 (88%)	12	76	
Typical associated symptoms	90 (90%)	13	77	1.000
Atypical associated symptoms	10 (10%)	1	9	

*Some patients had multiple associated symptoms. If a subject had both typical and atypical associated symptoms it was coded as an atypical associated symptom.

[1]Typical associated symptoms [2]Other = any associated symptom not listed, i.e., headache – coded as an atypical associated symptom

Table 10a

Final Diagnosis – Associated Symptoms

Associated Symptoms	Frequency (%)*	Final Diagnosis		*p* value
		ACS	NACS	
Shortness of breath[1]				
Yes	54 (54%)	16	38	0.748
No	46 (46%)	15	31	
Diaphoresis[1]				
Yes	43 (43%)	14	29	0.770
No	57 (57%)	17	40	
Syncope[1]				
Yes	1 (1%)	0	1	1.000
No	99 (99%)	31	68	
Presyncope[1]				
Yes	44 (44%)	13	31	0.780
No	56 (56%)	18	38	
Nausea/vomiting[1]				
Yes	36 (36%)	14	22	0.201
No	64 (64%)	17	47	
Palpitations[1]				
Yes	21 (21%)	4	17	0.183
No	79 (79%)	27	52	
Fatigue/weakness[1]				
Yes	11 (11%)	4	7	0.735
No	89 (89%)	27	62	
Other[2]				
Yes	21 (21%)	5	16	0.423
No	79 (79%)	26	53	
No associated symptoms[1]				
Yes	12 (12%)	3	9	0.750
No	88 (88%)	28	60	
Typical associated symptoms	90 (90%)	26	64	0.277
Atypical associated symptoms	10 (10%)	5	5	

*Some patients had multiple associated symptoms. If a subject had both typical and atypical associated symptoms it was coded as an atypical associated symptom.
[1]Typical associated symptoms [2]Other = any associated symptom not listed, i.e., headache – coded as an atypical associated symptom

Additional features. The majority of patients had symptoms that came on at rest (66%), were ongoing upon presentation to hospital (68%), did not change with palpation (75.6%) or respiration (77%), and were not localized to a small area (97%). As well, most had experienced similar episodes (66%) prior to this presentation (Table 11). Analysis of these additional features commonly elicited through the cardiac history

revealed patients whose symptoms changed with respiration were significantly more likely to have an atypical presentation than a typical one (χ^2 [1, N = 100] = 3.470, p = 0.035). There were no significant differences between additional features and final diagnosis (Table 11a).

Table 11

Symptom Presentation – Additional Features

Additional Features	Frequency (%)	Presentation		*p* value
		Typical	Atypical	
Came on with activity/stress				
N = 100				
Yes	34 (34.0%)	6	28	0.545
No	66 (66.0%)	8	58	
Ongoing at presentation				
N = 100				
Yes	68 (68.0%)	9	59	0.763
No	32 (32.0%)	5	27	
Similar prior episodes				
N = 100				
Yes	66 (66.0%)	9	57	1.000
No	34 (34.0%)	5	29	
Reproduced with palpation				
N = 86				
Yes	21 (24.4%)	1	20	0.279
No	65 (75.6%)	11	54	
Change with respiration				
N = 100				
Yes	23 (23.0%)	0	23	**0.035**
No	77 (77.0%)	14	63	
Localized to one finger width				
N = 100				
Yes	3 (3.0%)	0	3	1.000
No	97 (97.0%)	14	83	
Health seeking past 30 days				
N = 100	25 (25.0%)	6	19	0.108
Yes	75 (75.0%)	8	67	
No				

Table 11a

Final Diagnosis – Additional Features

Additional Features	Frequency (%)	Final Diagnosis		*p* value
		ACS	NACS	
Came on with activity/stress				
N = 100				
Yes	34 (34.0%)	11	23	0.834
No	66 (66.0%)	20	46	
Ongoing at presentation				
N = 100				
Yes	68 (68.0%)	17	51	0.059
No	32 (32.0%)	14	18	
Similar prior episodes				
N = 100				
Yes	66 (66.0%)	24	42	0.106
No	34 (34.0%)	7	27	
Reproduced with palpation				
N = 86				
Yes	21 (24.4%)	3	18	0.086
No	65 (75.6%)	22	43	
Change with respiration				
N = 100				
Yes	23 (23.0%)	4	19	0.108
No	77 (77.0%)	27	50	
Localized to one finger width				
N = 100				
Yes	3 (3.0%)	1	2	1.000
No	97 (97.0%)	30	67	
Health seeking past 30 days				
N = 100				
Yes	25 (25.0%)	11	14	0.105
No	75 (75.0%)	20	55	

Duration of Symptoms. Duration was defined as time from symptom onset until either symptom relief or time of history taking, whichever came first. The range in duration of symptoms was extremely wide, from 0.5 to 20160.0 minutes, or in other words, from a mere 30 seconds up to 14 days. The mean duration was 909.94 minutes (*SD* = 3206.02) or 15.2 hours, with a median of 150 minutes. By removing the two outliers, whose symptoms lasted for 14 days, the mean duration becomes 504.68 minutes (*SD* = 1564.26) or 8.5 hours. Both outliers had a final diagnosis of NACS. Duration was grouped into four categories. The most frequent duration by category for patients in both typical (*n* = 8/14, 57.1%) and atypical (*n* = 55/86, 64.0%) presentation groups was greater than 60 minutes as illustrated in Figure 4.

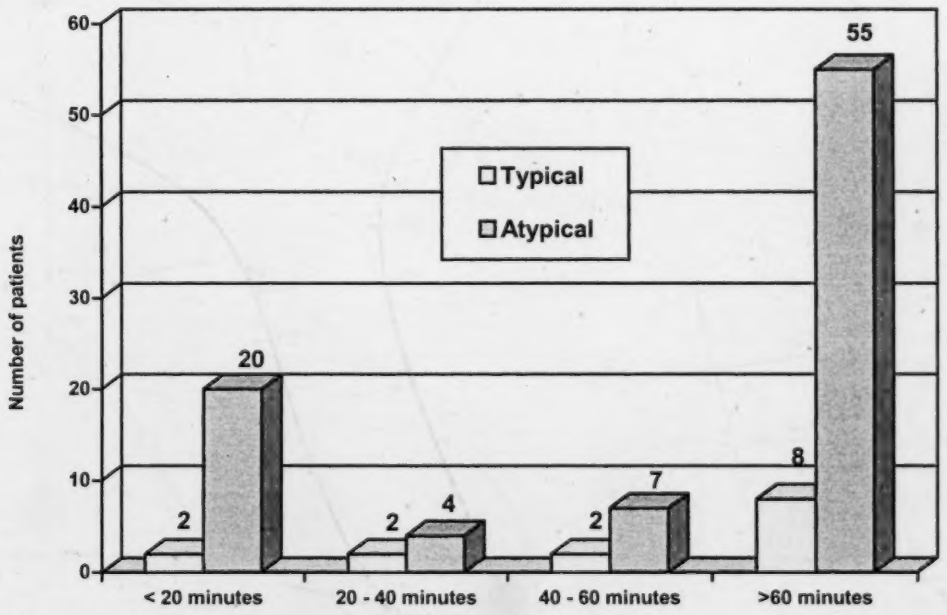

Figure 4. Symptom presentation and duration of symptoms.

Figure 5 depicts the duration of symptoms for patients with ACS and NACS. Again, the majority of patients with ACS (*n* = 18/31, 58.1%) had a duration of symptoms longer than 60 minutes, as did those with NACS (*n* = 45/69, 65.2%). Chi-square was not analyzed due to insufficient numbers in some groups.

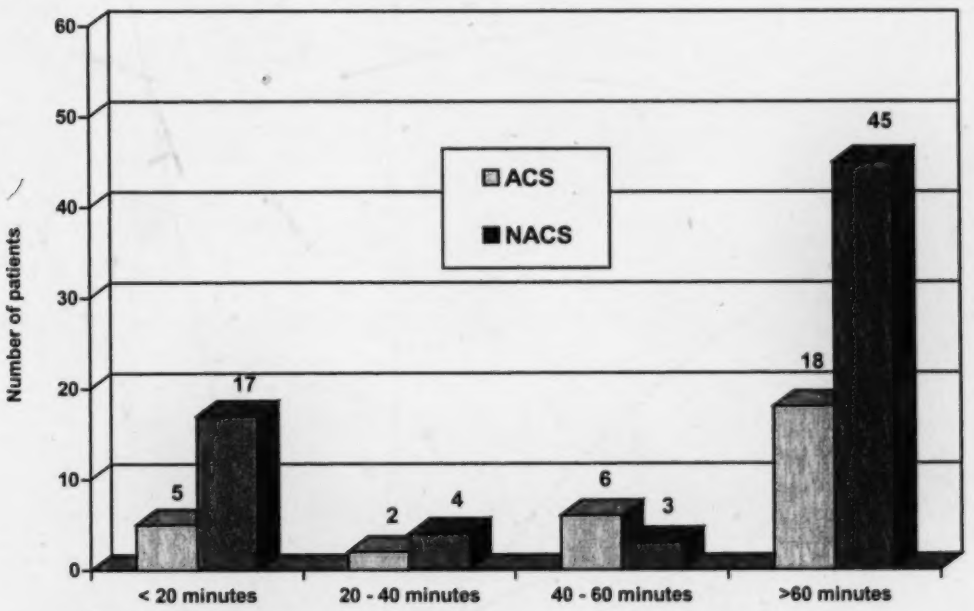

Figure 5. Final diagnosis and duration of symptoms.

Cardiovascular Risk Factors

The relationships between symptom presentation and cardiovascular risk factors (CRF), as well as final diagnosis and CRF were examined. The incidence of CRF is described in Table 12. Approximately one-fifth of the patients were diabetic (*n* = 20, 20%) or had smoked within the past five years (*n* = 21, 21%). More than half the sample had known hypertension (*n* = 61, 61.6%) or hyperlipidemia (*n* = 58, 62.4%). Whereas,

fewer than half had a family history of heart disease in a primary relative (n = 40, 41.2%). Seven patients had both diabetes and ACS; five of these seven (71.4%) had atypical presentations. The numbers were too small for analysis. There were no significant relationships found between CRF and symptom presentation, nor between CRF and final diagnosis (Tables 12 and 12a).

Table 12

Symptom Presentation – Cardiovascular Risk Factors

Risk Factor	Frequency (%)	Presentation		p value
		Typical	Atypical	
Diabetes mellitus				
N = 100				
Yes	20 (20.0%)	3	17	1.000
No	80 (80.0%)	11	69	
Hypertension				
N = 99				
Yes	61 (61.6%)	8	53	0.710
No	38 (38.4%)	6	32	
Hyperlipidemia				
N = 93				
Yes	58 (62.4%)	8	50	1.000
No	35 (37.6%)	5	30	
Smoker				
N = 100				
Yes	21 (21.0%)	4	17	0.485
No	79 (79.0%)	10	69	
Family history				
N = 97				
Yes	40 (41.2%)	6	34	0.894
No	57 (58.8%)	8	49	
History of ischemic heart disease				
N = 100				
Yes	44 (44.0%)	6	38	0.926
No	56 (56.0%)	8	48	

Table 12a

Final Diagnosis – Cardiovascular Risk Factors

Risk Factor	Frequency (%)	Final Diagnosis		*p* value
		ACS	NACS	
Diabetes mellitus				
N = 100				
Yes	20 (20.0%)	7	13	0.665
No	80 (80.0%)	24	56	
Hypertension				
N = 99				
Yes	61 (61.6%)	21	40	0.258
No	38 (38.4%)	9	29	
Hyperlipidemia				
N = 93				
Yes	58 (62.4%)	22	36	0.071
No	35 (37.6%)	7	28	
Smoker				
N = 100				
Yes	21 (21.0%)	9	12	0.186
No	79 (79.0%)	22	57	
Family history				
N = 97				
Yes	40 (41.2%)	16	24	0.155
No	57 (58.8%)	15	42	
History of ischemic heart disease				
N = 100				
Yes	44 (44.0%)	19	25	**0.020**
No	56 (56.0%)	12	44	

History of Ischemic Heart Disease

The relationship of past history of ischemic heart disease (IHD) to symptom presentation and final diagnosis was examined (Tables 12 and 12a). Nearly half of the sample had a history of IHD (*n* = 44, 44%). Patients with a history of IHD were just as

likely to have typical as atypical presentations (χ^2 [1, N = 100] = 0.009, p = 0.926). Whereas, patients with IHD had a significantly higher likelihood of having a final diagnosis of ACS (χ^2 [1, N = 100] = 5.451, p = 0.020).

Prior Health Care Seeking Behavior

The relationship between health care seeking behavior for similar symptoms within 30 days prior to the current presentation and typical and atypical presentation, and between health care seeking behavior and the diagnosis of ACS and NACS was explored (Tables 11 and 11a). Twenty-five patients (25%) presenting to the CPP had sought care at a primary, community, or tertiary care provider for similar symptoms within the previous 30 days. Six of these 25 (24%) presented typically and 19 (76%) had atypical presentations. This relationship was not significant (χ^2 [1, N = 100] = 1.772, p = 0.108). Furthermore, 11 of 25 patients who previously sought care (44%) had a final diagnosis of ACS, while 14 (56%) had NACS. Again, a significant relationship was not seen (χ^2 [1, N = 100] = 2.634, p = 0.105).

Diagnostic Findings

Finally, the relationship between diagnostic findings and typical and atypical presentation, as well as diagnostic findings and diagnosis of ACS and NACS was examined. A total of five patients had positive electrocardiograms (ECG): two positive at 0 hour ECG, two positive at 6-hour ECG, and one positive at both time intervals. Two of the three patients with a positive initial ECG, and one of the three positive at 6-hours, had typical presentations (Table 13). The relationship between symptom presentation and ECG findings was not significant. All five patients with a positive ECG had a diagnosis of ACS; patients with a positive ECG had a significantly higher likelihood of having a final diagnosis of ACS versus NACS at both 0 hour (χ^2 [1, N = 100] = 3.960,

$p = 0.028$) and 6 hour ECG (χ^2 [1, $N = 97$] = 4.218, $p = 0.025$) (Table 13a).

Cardiac markers, including CK/CK-MB and Troponin I at 0 hours, as well as Troponin I at 6 hours, were recorded for the study. Two percent ($n = 2$) of the sample had positive CK/CK-MB, 4% ($n = 4$) had a positive Troponin I at the 0 hour mark, and 8.2% ($n = 8$) of the sample had positive Troponin I at 6 hours; two patients had positive Troponins at both 0 and 6 hours. One of two, two of four, and two of eight patients respectively had a typical presentation. There were no significant differences between cardiac markers and presentation (Table 13). Two of two patients with positive CK/CK-MB, three of four with positive Troponin I at 0 hour (one false positive), and eight of eight with positive Troponin I at 6 hours had a diagnosis of ACS. However, only patients with a positive Troponin I at 6 hours were significantly more likely to have a final diagnosis of ACS (χ^2 [1, $N = 98$] = 16.348, $p < 0.001$) (Table 13a).

Exercise testing (ETT) was performed on 49% ($n = 49$) of patients; eleven (22.4%) positive, 20 (40.8%) negative, and 18 (36.7%) inconclusive. Two of the 11 patients with a positive ETT had a typical presentation and four of 11 had ACS. Of the 20 patients with a negative ETT, three had typical presentations and all were assigned a final diagnosis of NACS. Finally, out of the 18 inconclusive tests, 1 patient had a typical presentation and 5 had ACS. The numbers were insufficient for subgroup analysis.

Nuclear imaging (MIBI) was performed on patients that were unable to undergo ETT due to physical limitations, a baseline ECG that precluded ETT interpretation, following inconclusive ETT if clinically warranted, or after admission in some cases. A total of 29 MIBI scans were performed of which 8 (27.6%) were positive for cardiac ischemia and 21 (72.4%) were negative (Table 13). Only one of the 8 patients with a positive MIBI scan had a typical presentation. There was no relationship between MIBI

result and presentation (χ^2 [1, N = 29] = 0.000, p = 1.000). All 8 patients with a positive MIBI were assigned a diagnosis of ACS (χ^2 [1, N = 29] = 24.210, p < 0.001) (Table 13a).

Stress echocardiography was performed in place of MIBI scanning on four patients; one (25%) was positive for ischemia and three (75%) were negative. Based on the positive result, this one patient was assigned a diagnosis of ACS. Neither the patient with ACS nor the other three had typical presentations. The numbers were insufficient to perform chi-square analysis for stress echo and presentation, and there was no significance when analyzed against final diagnosis (χ^2 [1, N = 4] = 0.444, p = 0.250).

Finally, coronary angiography (CA) was performed on 21 (21%) patients, usually following positive ETT or after admission with UA or NSTEMI. Of the 21 who underwent this procedure, 15 (71.4%) were positive (stenosis > 70%), and 6 (28.6%) were negative. Of interest, all six patients with negative CA were female. Four of the 15 patients with a positive CA and one of the six with a negative CA had typical presentations. There was no relationship between presentation and CA findings (χ^2 [1, N = 21] = 0.000, p = 1.000). All of the patients with a positive CA were given a final diagnosis of ACS (χ^2 [1, N = 21] = 16.386, p < 0.001). Figure 6 illustrates the 100 study patients enrolled in the CPP. Patients were subdivided into groups according to risk of ACS based on initial clinical judgment and prior to provocative testing. Diagnostic investigation results and final diagnosis are also shown.

Table 13

Symptom Presentation – Diagnostic Investigation Results

Diagnostic Investigations	Frequency (%)	Presentation		*p* value
		Typical	Atypical	
ECG at 0 hour				
N = 100				
Positive	3 (3.0%)	2	1	0.051
Negative	97 (97.0%)	12	85	
ECG at 6 hours				
N = 97				
Positive	3 (3.1%)	1	2	0.377
Negative	94 (96.9%)	13	81	
CK/CK-MB at 0 hour				
N = 100				
Positive	2 (2.0%)	1	1	0.262
Negative	98 (98.0%)	13	85	
Troponin at 0 hour				
N = 100				
Positive	4 (4.0%)	2	2	0.093
Negative	96 (96.0%)	12	84	
Troponin at 6 hours				
N = 98				
Positive	8 (8.2%)	2	6	0.320
Negative	90 (91.8%)	12	78	
Exercise stress test				
N = 49				
Positive	11 (22.4%)	2	9	
Negative	20 (40.8%)	3	17	
Inconclusive	18 (36.7%)	1	17	
MIBI				
N = 29				
Positive	8 (27.6%)	1	7	1.000
Negative	21 (72.4%)	2	19	
Stress echocardiography				
N = 4				
Positive	1 (25.0%)	0	1	
Negative	3 (75.0%)	0	3	
Coronary angiography				
N = 21				
Positive	15 (71.4%)	4	11	1.000
Negative	6 (28.8%)	1	5	

Table 13a

Final Diagnosis – Diagnostic Investigation Results

Diagnostic Investigations	Frequency (%)	Final Diagnosis ACS	Final Diagnosis NACS	*p* value
ECG at 0 hour				
N = 100				
Positive	3 (3.0%)	3	0	**0.028**
Negative	97 (97.0%)	28	69	
ECG at 6 hours				
N = 97				
Positive	3 (3.1%)	3	0	**0.025**
Negative	94 (96.9%)	26	68	
CK/CK-MB at 0 hour				
N = 100				
Positive	2 (2.0%)	2	0	0.094
Negative	98 (98.0%)	29	69	
Troponin at 0 hour				
N = 100				
Positive	4 (4.0%)	3	1*	0.087
Negative	96 (96.0%)	28	68	
Troponin at 6 hours				
N = 98				
Positive	8 (8.2%)	8	0	**< 0.001**
Negative	90 (91.8%)	22	68	
Exercise stress test				
N = 49				
Positive	11 (22.4%)	4	7	
Negative	20 (40.8%)	0	20	
Inconclusive	18 (36.7%)	5	13	
MIBI				
N = 29				
Positive	8 (27.6%)	8	0	**< 0.001**
Negative	21 (72.4%)	0	21	
Stress echocardiography				
N = 4				
Positive	1 (25.0%)	1	0	0.250
Negative	3 (75.0%)	0	3	
Coronary angiography				
N = 21				
Positive	15 (71.4%)	15	0	**< 0.001**
Negative	6 (28.8%)	0	6	

*One subject had a positive troponin at 0 hour (0.61) and a negative troponin at 6 hours (< 0.15)

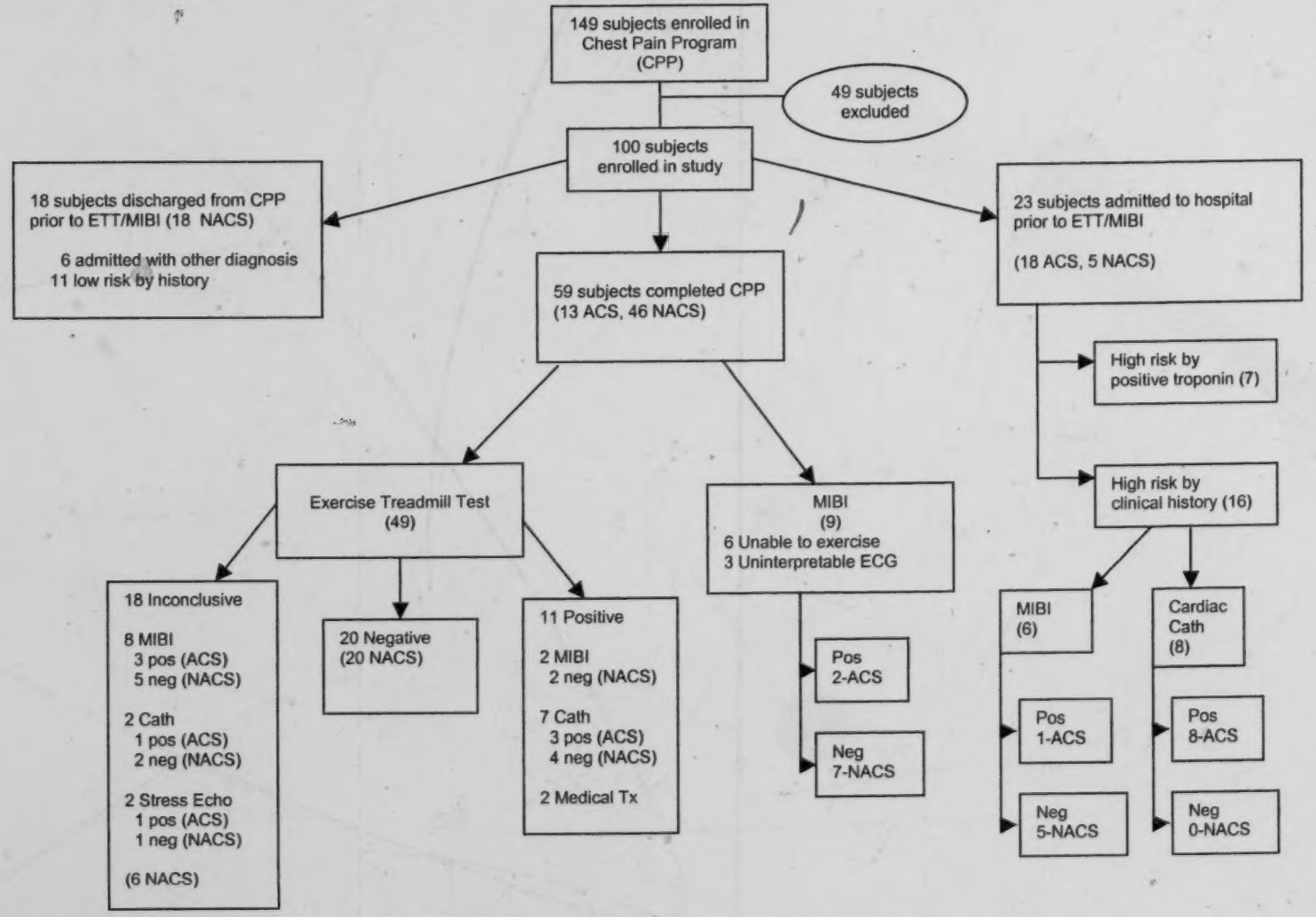

Figure 6. Diagnostic investigation results and final diagnosis.

Nurse Practitioner Impression of the Likelihood of ACS

In the majority of cases, the ED physician and Cardiologist were unavailable to obtain their impression of the patient's likelihood for cardiac disease. Therefore, these data were not analyzed. However, the Nurse Practitioner (NP) for the CPP (the researcher) categorized patients into groups according to high or low likelihood of ACS, in addition to assigning a designation of typical or atypical presentation based on predetermined study criteria. These designations were done after taking the patient's history and prior to provocative testing; i.e., ETT or MIBI. Data were collected for 63 patients; just under half were classified as having a high likelihood for ACS (n = 31, 49.2%) versus those assigned a low likelihood (n = 32, 50.8%) (Table 14). Nine of 31 (29.0%) patients assigned a high likelihood for ACS also had a typical presentation by study definition (χ^2 [1, N = 63] = 5.671, p = 0.017).

Eighteen of the 63 patients had a final diagnosis of ACS; 45 had a final diagnosis of NACS. Of the 31 patients assigned a high likelihood of ACS, 16 (51.6%) had a final diagnosis of ACS; whereas, only 2 (6.3%) of the 32 patients assigned a low likelihood of ACS had a final diagnosis of ACS. In other words, 16 of the 18 patients with ACS were correctly identified by the NP (88.9%); 30 of the 45 patients with NACS were correctly identified by the NP (66.7%) (χ^2 [1, N = 63] = 15.877, p < 0.001) (Table 14a).

Table 14

Symptom Presentation – Nurse Practitioner Likelihood of ACS

NP Likelihood	Frequency (%)	Presentation		*p* value
		Typical	Atypical	
High Likelihood	31 (49.2%)	9	22	**0.017**
Low Likelihood	32 (50.8%)	2	30	

Table 14a

Nurse Practitioner Prediction – Sensitivity and Specificity

NP Prediction	ACS	NACS	Total	*p* value
High Likelihood	16 (88.9%)	15 (33.3%)	31	**< 0.001**
Low Likelihood	2 (11.1%)	30 (66.7%)	32	
Total	18	45	63	

CHAPTER FIVE

Discussion

This study examined the presentation of acute coronary syndromes (ACS); specifically, typical versus atypical symptoms in individuals that presented to the University of Alberta Hospital Chest Pain Program (CPP). Of the 149 patients enrolled in the CPP during the period of data collection, September to November 2002, 100 patients consented to participate in the study. Data were collected prospectively through taking of the patient's history and recording of diagnostic results from the health record. A comparative design using descriptive statistics and chi-square analysis examined the relationship between symptom presentation and the diagnosis of ACS, cardiovascular risk factors, history of ischemic heart disease, prior health care seeking behavior, diagnostic findings, and Nurse Practitioner (NP) impression of the likelihood of ACS.

Only 14% of patients in this study had typical presentations; 86% presented with atypical symptoms. The majority of patients with a final diagnosis of ACS had an atypical presentation (74.2%). However, patients with typical presentations were significantly more likely to have a final diagnosis of ACS than no ACS (NACS).

The most common chief complaint experienced by patients in this sample was chest pain (78%). Most of the patients who presented atypically had chest pain (64%), but they did not meet study criteria for typical presentation because of one or more atypical features. Seven patients with atypical presentation had a combination of chest pain and a second chief complaint, and 15 patients had a chief complaint other than chest pain. A significantly higher proportion of patients with typical presentation had chest pain when compared with those with atypical presentations. No significant differences were found between final diagnosis and chief complaint. The only symptom

characteristic found to be significantly associated with ACS was location. No symptom qualities were found to be associated with ACS, although there was a trend toward squeezing discomfort being associated with NACS. As well, there was a trend toward the aggravating factor of exertion/stress among patients with ACS.

Males were significantly more likely than females to have a diagnosis of ACS. However, there was no relationship between gender and symptom presentation. No significant differences were found in symptom presentation or final diagnosis by age, body mass index (BMI), or ethnicity.

There were no statistically significant associations between symptom presentation or final diagnosis and any of the cardiovascular risk factors. Patients with a history of ischemic heart disease had a significantly higher likelihood of having a final diagnosis of ACS, but no relationship to symptom presentation was found. Patients who had sought care for similar symptoms in the 30 days previous to study presentation did not demonstrate a significant relationship to either symptom presentation or final diagnosis. There were no significant differences between diagnostic findings and symptom presentation.

Demographics of the Sample

There was nearly an equal split between males (52%) and females (48%) in this sample. Studies that looked at ED visits for chest pain or other symptoms suspicious of ACS had similarly equal splits between genders (Cunningham et al., 1989; Lehmann et al., 1996; Milner et al., 2002; Silbergleit & McNamara, 1995). It was encouraging that women were enrolled in equal numbers to men in the CPP.

The average age of patients in the study was 61 years, with a range in age from 34 – 95 years. This is consistent with the literature, where the mean age ranged from 50

to 73, with a somewhat younger cohort when all comers to the ED were included (Cunningham et al., 1989; Lehmann et al., 1996; Silbergleit & McNamara, 1995), and an older cohort when ACS was documented, in particular UA (Canto et al., 2002; Kudenchuk et al., 1996; Marrugat et al., 1998; Milner et al., 2002; Meischke et al., 1998; Penque et al., 1998).

Most of the patients were obese (60%), defined as a BMI of greater than 27, which is much higher than what was seen in the general population (Health Canada, 2000). The rate of obesity, using the same definition of BMI > 27, was 33.0% for Albertans and 31.9% for all of Canada (Predy, 2003). As obesity has been linked to coronary artery disease (Libby et al., 2002; Sato et al., 1992), these patients may have been seen, by the physicians enrolling patients into the CPP, as being at higher risk of ACS than non-obese patients.

The majority of subjects were Caucasian (86%). Although this is somewhat lower in percentage than was reported in the literature (88 – 100%) (Applegate et al., 1984; Canto et al., 2002; Kudenchuk et al., 1996; Meischke et al., 1998; Penque et al., 1998), it is consistent with Canadian statistics. According to the 2001 Census, Caucasians made up 86.7% of the population of Canada (Statistics Canada, 2002b). As well, patients not able to speak or understand English were excluded from participation in the study. This may have resulted in a higher percentage of Caucasian subjects.

Incidence of Typical and Atypical Presentation

Patients in this study were divided into two groups based on symptoms at presentation. Typical presentation was defined using the traditional description for angina: chest pain or discomfort of a characteristic location (mid/sub/retrosternal, may radiate to neck, jaw, epigastrium, or arms) and quality (pressure, heaviness, tightness),

that may be precipitated or exacerbated by physical or emotional stress, and is usually relieved with rest or nitroglycerine; rest pain may occur (Braunwald et al., 2000; Gibbons et al., 1999). Atypical presentation included all those who had chest pain that did not meet typical criteria or symptoms other than chest pain.

The incidence of typical presentation in the sample was 14%. This rate was lower than what was seen in the literature, where typical presentation ranged from 30.8% to 99% (Applegate et al., 1984; Canto et al., 2000; Canto et al., 2002; Gregor et al., 1994; Gupta et al., 2002; Karlson et al., 1994; Kudenchuk et al., 1996; Meischke et al., 1998; Milner et al., 2002; Paul et al., 1996; Penque et al., 1998; Raine et al., 1999; Then et al., 2001; Uretsky et al., 1977). However, these studies used more liberal definitions of typical presentation than was utilized for the purposes of this study. Some investigators included neck, jaw or arm pain along with all locations of chest pain in the typical cohort (Canto et al., 2000; Canto et al., 2002; Gupta et al., 2002; Meischke et al., 1998; Uretsky et al., 1977). Others included symptoms other than pain, like dyspnea and diaphoresis, in their definition of typical (Milner et al., 2001; Milner et al., 2002). Many studies simply looked at presence of any type of chest pain (typical presentation) versus no chest pain (atypical presentation) (Karlson et al., 1994; Kudenchuk, et al., 1996; Paul et al., 1996; Penque et al., 1998; Then et al., 2001; Uretsky et al., 1977). The study closest to this investigation, in terms of definition, was Canto et al. (2002); they found 48.3% of patients with UA presented typically.

There are likely two explanations for the low incidence of typical presentation in this study. First, the definition for typical presentation was conservative. The patient needed to have chest pain or discomfort that met typical criteria for location, radiation, and quality of symptoms to be classified as typical presentation. This definition may be

too narrow to encompass the wide range of symptoms patients experience with ACS. In choosing a stricter definition, the author tried to reflect what is taught in the literature about symptoms of ischemic origin (Braunwald et al., 2000; Gibbons et al., 1999; Lee, 2002), and consequently, what may be considered by clinicians when they see patients at the bedside. Experienced clinicians likely use a comprehensive gestalt of symptom features when formulating an initial impression of the patient's likelihood of ACS (Murata, 1993). Unfortunately, patients may not be seen by these experts until much later in the course of their illness. Usually, the patient's entry into the health care system with complaints of this nature is through their family practitioner or perhaps an ED triage nurse or ED physician. These caregivers may not be familiar with all the subtleties of atypical presentation in ACS. Canto et al. (2002) summarize, "National educational initiatives may need to redefine the classic presentation of UAP to include atypical presentations to ensure appropriate quality of care" (p. 248).

A second reason why the incidence of typical presentation was lower in this sample than what is seen in the literature may be due to the population the sample is drawn from. The CPP is for patients that are considered to be at moderate risk for ACS, that is, patients who need an added step of risk stratification (exercise test or nuclear imaging) in order to arrive at a final diagnosis. Patients presenting to the ED with more typical symptoms suspicious for ACS, that is, a convincing or very typical history, may be identified as high risk by the ED physician and consequently referred directly to the Cardiology service for admission to hospital. These patients would not be enrolled into the CPP and would not have been captured in the sample thereby reducing the incidence of typical presentation seen.

More males (57.1%) than females (42.9%) had typical presentations but this relationship was not significant. Most studies that looked at gender and symptom presentation support this trend (Cunningham et al., 1989; Goldberg et al., 1998; Gupta et al., 2002; Meischke et al., 1998). However, two studies found there was no difference between gender and presentation (Kudenchuk et al., 1996; Penque et al., 1998).

The same number of older and younger patients had typical presentations and there was no significant relationship found between age and symptom presentation. These findings are not consistent with other studies, where older patients were significantly more likely to present atypically (Applegate et al., 1984; Canto et al., 2000; Gupta et al., 2002; Madias et al., 1995; Milner et al., 2001; Paul et al., 1996; Then et al., 2001; Uretsky et al., 1977). This may be explained, in part, by the small number of patients with typical presentation in this study.

Slightly more obese than non-obese patients had typical presentations but this relationship was not significant. Only one study discussed obesity and symptom presentation (Sato et al., 1992); these authors also found no significant difference in obesity between typical and atypical cohorts.

All of the 14 non-Caucasian patients had atypical presentations. However, no significant differences were found between typical and atypical symptom presentation on the variable of ethnicity. The few studies that looked at ethnicity and presentation had contradictory findings. One study (Gupta et al., 2002) found non-whites had less atypical presentations; whereas, Canto et al. (2000) found the opposite, that more non-whites presented atypically. Finally, Canto et al. (2002) found no difference.

Symptom Presentation and Acute Coronary Syndromes

This study was unique in that it examined symptom presentation among patients enrolled in a CPP who are thought to be at moderate risk of ACS. High risk patients needing immediate admission, and low risk patients with an alternate diagnosis to explain symptoms were excluded. Of the 100 patients enrolled in this study, 31% had a confirmed diagnosis of ACS. Although no studies were found that looked at a similar cohort of moderate risk patients, the literature does report up to 40% of patients presenting to an ED with chest pain have an etiology of ACS (Cunningham et al., 1989; Lee et al., 1985; Pope et al., 2000; Solomon et al., 1989; Wilkinson & Severance, 2001). In light of this, our numbers were slightly higher than expected when you consider the CPP does not enroll patients at high risk for ACS. A higher percentage of patients with ACS likely would have been seen if all comers to the ED were included. As well, 18 patients enrolled in the CPP were deemed low risk for ACS, based on symptom history and negative ECG/cardiac markers, and subsequently discharged from the CPP without undergoing provocative testing. This creates the potential, albeit low, for missed diagnosis of ACS in these persons.

Of the 31 study patients with a final diagnosis of ACS, the majority (74.2%) had atypical presentations. As described in the previous section, this is somewhat consistent with the literature depending on how typical and atypical presentations are defined. Many studies have documented patients with ACS frequently present with atypical symptoms (Canto et al., 2000; Canto et al., 2002; Gupta et al., 2002; Lee et al., 1985; Milner et al., 2000; Milner et al., 2002; Then et al., 2001; Uretsky et al., 1977). However, ACS patients were still more likely to present typically than their NACS counterparts. That is, a significantly higher proportion of patients had typical symptoms in the ACS

cohort as compared with the NACS group. However, the high incidence of atypical presentation among the ACS group in this study reinforces atypical symptoms should not be ignored when patients present to the ED with complaints suspicious of ACS (Milner et al., 2002).

For the purpose of this study, older age was defined as 65 years and above. Slightly more older (58.1%) than younger (41.9%) patients had ACS; this is in keeping with what was found in the literature (Milner et al., 2001; Paul et al., 1996; Solomon et al., 1989; Tresch & Alla, 2001). When age and final diagnosis of ACS were compared with symptom presentation, younger patients with ACS had a higher incidence of atypical presentation (77.8%) than older patients with ACS (69.2%). This relationship was not statistically significant. This finding conflicts with what was found in the literature where older patients with ACS were more likely to have atypical presentations (Applegate et al., 1984; Cocchi et al., 1988; Day, Bayer, Pathy, & Chadha, 1987; Kannal & Abbott, 1984; Milner et al., 2001; Paul et al., 1996; Solomon et al., 1989; Then et al., 2001). The small numbers in this study, especially for the typical presentation cohort, may have influenced results. Possibly the arbitrary age cutoff of 65 years did so as well, as a few studies found the older the patient the more atypical the presentation (Day et al., 1987; Paul et al., 1996), particularly for older men (Then et al., 2001). Finally, other studies dealt with patients of higher risk; whereas, this study dealt with a unique population of moderate risk patients.

Of the 31 patients with a final diagnosis of ACS, significantly more were male (67.7%) than female (32.3%). Studies that looked at patients with confirmed ACS found 50% - 75% of patients with acute myocardial infarction (AMI) were male (Goldberg et al., 1998; Gupta et al., 2002; Marrugat et al., 1998; Meischke et al., 1998; Solomon et al.,

1989); the numbers were less divergent for patients with UA but men still tended to outnumber women (Canto et al., 2002; Solomon et al., 1989). More men (76.2%) than women (70%) had both ACS and atypical presentations, although this difference was not statistically significant. Again, this was unexpected based on what is reported in the literature. Numerous studies showed women were more likely to have atypical presentations compared to their male counterparts (Goldberg et al., 1998; Gupta et al., 2002; Karlson et al., 1994; Meischke et al., 1998). One study by Kudenchuk and colleagues (1996) did not find a difference based on gender, however, 99% of their sample had chest pain as a presenting symptom and all were AMI patients who met criteria for thrombolysis; a very different population than the other studies. Milner et al. (2002) also found no difference between men and women in that the adjusted relative risk for ACS in women with typical symptoms (defined as chest, arm or shoulder discomfort, diaphoresis, or dyspnea) compared with men with typical symptoms was close to 1.0.

Slightly more obese than non-obese patients had ACS but this difference was not significant. Sato et al. (1992) found similar results. Although the numbers are too small to make any generalizations, all three of the 14 non-Caucasians who had ACS presented atypically. There was no significant difference between ethnicity and final diagnosis. This is consistent with the findings of Canto et al. (2002).

Chief Complaints

The most common chief complaint experienced by the sample was chest pain (78%), of which 14% met criteria for typical presentation. Of the patients that presented atypically, chest pain was the most common chief complaint (64%), next was epigastric/abdominal pain (4%) and chest pain in combination with dyspnea (4%),

followed by back/interscapular pain (3%), left arm pain (2%), dizziness (2%), chin/lip/neck numbness (1%), jaw pain (1%), left shoulder and arm pain (1%), left shoulder and neck pain (1%); and finally, chest pain combined with epigastric pain (1%), dizziness (1%), or left shoulder pain (1%). Chest pain as the most frequent chief complaint in both the typical and atypical cohorts is consistent with the literature (Meischke et al., 1998; Milner et al., 2002; Penque et al., 1998). However, a higher frequency of dyspnea, syncope, fatigue, nausea, and diaphoresis in the absence of chest discomfort as presenting symptoms of ACS was cited in the literature, which was not evident in this study (Canto et al., 2000; Canto et al., 2002; Gupta et al., 2002; Madias et al., 1995; Milner et al., 2001; Milner et al., 2002; Uretsky et al., 1977; Zarling et al., 1983). One possible explanation is that these patients are not being identified in the ED as potential angina equivalents and consequently not enrolled in the CPP. The CPP inclusion criteria do not rely solely on symptom history in an effort to include patients with symptoms other than chest pain, but ultimately the ED physician decides who will be enrolled in the CPP. Finally, the sample size in this study may have limited the range of symptoms seen.

The chief complaint of 'chest pain only' was the only symptom to show a significant relationship with symptom presentation, as all patients (100%) with a typical presentation had this as their chief complaint. Other studies also found that patients with a chief complaint of chest pain tended to have typical presentations (Canto et al., 2000; Gupta et al., 2002; Kudenchuk et al.). None of the chief complaints were significantly related to final diagnosis. No studies could be found that looked at individual symptom characteristics in the same degree of detail as this study. Usually, the only reference to location, quality, radiation, etc. was in terms of how they defined typical presentation; if

the patient was assigned to the atypical group they did not exhibit these characteristics. Some studies did not specify which locations, qualities, etc. they considered typical or atypical. A few studies went into more depth about associated symptoms and additional features. Some of the literature compared symptom characteristics with gender (Cunningham et al., 1989; Goldberg et al., 1998; Kudenchuk et al., 1996; Meischke et al., 1998) or age (Applegate et al., 1984; Milner et al., 2001; Solomon et al., 1989), but as this study did not, comparisons were not relevant.

The most commonly occurring symptom location in this study is also the location considered to be most typical of ischemic pain, that is, mid/sub/retrosternal (39%) (Braunwald, 1997; Gibbons et al., 1999; Lee, 2002). Other studies also showed retrosternal location to be the most frequent (Applegate et al., 1984; Cunningham et al., 1989; Lehmann et al., 1996; Solomon et al., 1989). A significantly higher proportion of patients with typical location also had typical presentations. Patients complaining of pain in the atypical location of left middle chest, the next most frequent location (26%), were more likely to have an atypical presentation. Both results are in keeping with the definition of typical presentation used for this study. No other locations showed a significant difference with presentation. Although nearly one-half of the patients with a final diagnosis of ACS (48.4%) had atypical locations, a significantly higher proportion of patients with ACS versus NACS had typical locations.

Quality of pain is used by clinicians to assess likelihood of ACS (Braunwald, 1997). The four most frequent qualities used by patients to describe their symptoms were pressure (23%), sharp (21%), tightness (18%), and heaviness (17%). This is similar to what was seen in Cunningham et al. (1989). Quality of pain was significantly related to symptom presentation; that is, if patient's had typical qualities, specifically pressure, they

were more likely to have a typical presentation, and if they had atypical qualities, specifically sharp, they were more likely to present atypically. Again, this is in keeping with the criteria that were used to define typical presentation. Just over half of the patients with ACS had atypical qualities; for example, just as many patients with ACS had the atypical quality of sharp as had the typical qualities of tightness or heaviness, and more ACS patients had sharp discomfort than had pressure. Canto et al. (2002) found 14.4% of patients had atypical chest pain with burning or sharp qualities. A few patients with ACS also had other atypical qualities including stabbing, burning, pinching, and throbbing. There was no significant relationship found between quality and final diagnosis; although, there were trends toward an association between squeezing pain and NACS, and dull pain and ACS. These findings are consistent with the literature in that quality is a poor discriminator of ACS (Canto et al., 2002; Lee et al., 1985) and practitioners should use caution when basing clinical decisions on this symptom characteristic. Patients may differ in how they define terms, i.e., some may use 'sharp' to describe the intensity rather than quality of the discomfort (Lee, 2002). Furthermore, there can be cultural, social, geographical, and gender differences in choice of words (Albarran et al., 2000; Wilkinson & Severance, 2001).

Radiation of symptoms to the neck, jaw, arms and epigastrium is considered typical (Gibbons et al., 1999). Pain most frequently radiated to the left arm (26%), or neck/jaw/throat (23%), considered typical, as well as, to the back/interscapular region (16%), defined as atypical; 21% of patients had no radiation of their symptoms. Of the 31 patients with a final diagnosis of ACS, 87.1% had typical radiation of symptoms. There was no significant relationship identified between radiation and symptom presentation

nor radiation and final diagnosis. No studies were found that looked at radiation in terms of typical versus atypical presentation.

Typical aggravating factors include physical or emotional stress (Braunwald et al., 2000; Gibbons et al., 1999). Fifty-two percent of the sample had features that aggravated their symptoms, including 24% whose symptoms were exacerbated by physical exertion or emotional stress; 48% had no aggravating factors. The most frequent atypical aggravation was breathing (14%), followed by recumbent or supine positioning (10%), changing of position (10%) and palpation over the site of discomfort (8%). Although there was a trend toward patients with ACS having symptoms aggravated by physical or emotional stress, more patients with ACS (13) than not (11) had symptoms that were not aggravated by these factors. As well, an equal number of patients with ACS and NACS (5) had symptoms aggravated by the atypical feature of lying supine or in a recumbent position. No significant differences were found for aggravating factors by presentation or final diagnosis. No studies were found that compared aggravation of symptoms on these variables.

The typical alleviating factors of nitroglycerine (47%) and rest (37%) were those most commonly seen in the study. Only 12% of patients had no alleviating factors. Patients with typical alleviating factors were significantly more likely to have typical presentations. Unlike the other characteristics that were related to symptom presentation, typical alleviating factors were not a part of the definition for typical presentation, so the association cannot be explained on this basis. Of the 31 patients with a final diagnosis of ACS, 64.5% had typical alleviating factors and 35.5% had atypical factors; however, this relationship was not significant. Again, no studies were found that looked at alleviation of symptoms in terms of presentation or final diagnosis.

There were no significant relationships found between associated symptoms and presentation or final diagnosis. The most frequent associated symptom was dyspnea (54%), followed by dizziness/lightheadedness (44%), diaphoresis (43%), nausea and/or vomiting (36%), palpitations (21%), fatigue/weakness (11%), and syncope (1%); 12% of patients had no associated symptoms and 21% had symptoms categorized as other, including infrequently encountered atypical symptoms such as headache, cough, etc. These findings are similar to what was found in the literature (Kudenchuk et al., 1996; Meischke et al., 1998; Penque et al., 1998). The presence of atypical associated symptoms do not preclude the diagnosis of ACS (Braunwald et al., 2000), as was seen in five patients with ACS in this study that experienced either headache, hot feeling, midsternal burning, left leg numbness, or a pounding head.

Additional features commonly elicited as part of a cardiac history were recorded for the sample. The majority of patients had symptoms that came on at rest (66%), were ongoing upon presentation to hospital (68%), did not change with palpation (75.6%) or respiration (77%), and were not localized to a small area (97%); as well, most had experienced similar episodes (66%) prior to this presentation (Table 11). Of these features, analysis revealed only patients whose symptoms changed with respiration were significantly related to presentation; that is, they were more likely to have an atypical presentation than a typical one. Symptoms that change with respiration are generally considered atypical and unlikely to be cardiac in origin (Braunwald et al., 2000; Lee, 2002). Three of the 31 patients (9.7%) with a final diagnosis of ACS had symptoms reproduced by palpation, 4 (12.9%) had symptoms that changed with respiration, and 1 (3.2%) had localized discomfort, all signs Lee et al. (1985) found patients with AMI were significantly less likely to have. There were no significant differences between additional

features and final diagnosis. However, there were trends toward symptoms that were ongoing at presentation or reproducible with palpation as associated with NACS.

In summary, of the individual symptom characteristics, location, quality, alleviating factors, and symptoms that changed with respiration were significantly related to presentation. The only individual characteristics found to be significantly related to ACS was location. Although quality of pain is an integral part of the traditional definition for ACS presentation, no qualities were found to be related to ACS in this cohort. The same holds for radiation of pain, and aggravating and alleviating factors, also classic features of the traditional description of angina.

Ischemic pain is generally thought to last under 20 minutes, but can be prolonged in UA; pain with AMI can last several hours (Braunwald et al., 2000; Gibbons et al., 1999). There was a wide range in duration of symptoms in this study, from less than one minute up to 14 days. The median duration was 150 minutes. Duration was grouped into categories of 20 minutes (< 20 minutes, 20 – 40 minutes, 40 – 60 minutes, and > 60 minutes). Most patients in both the typical and atypical presentation cohorts had pain that lasted longer than 60 minutes, as did most patients with ACS and NACS. The median duration of symptoms for patients with typical presentation was 1.75 hours, and median duration for atypical presentation was 2.5 hours. The median duration of symptoms for patients with ACS was 1.5 hours (NSTEMI – 2.75 hours; UA – 1.25 hours), and median duration for NACS was 3.5 hours. Several studies commented on duration of symptoms in terms of delay based on gender and age; but only one study (Uretsky et al., 1977) compared typical and atypical presentation; the median delay was 4 hours in the typical group versus 12 hours in the atypical groups ($p < 0.05$).

Cardiovascular Risk Factors

Approximately one-fifth of the patients in this study were diabetic (20%). A similar percentage had smoked within the past five years (21%). More than half the sample had known hypertension (61.6%) or hyperlipidemia (62.4%); whereas, fewer than half had a family history of heart disease in a primary relative (41.2%). Seven patients had both diabetes and ACS; five of these seven (71.4%) had atypical presentations. Although the presence of CRF are part of the inclusion criteria for enrollment into the CPP, there was no significant relationship found between CRF and symptom presentation, nor between CRF and final diagnosis. Madias and colleagues (1995) similarly found no relationship; however, the literature is somewhat contradictory in regards to presentation and CRF. Uretsky et al. (1977) found non-smokers were more likely to present atypically; whereas, Sato et al. (1992) found the opposite. Sato et al. (1992) and Canto et al. (2002) both reported patients who presented atypically were less likely to have hyperlipidemia. Canto et al. (2002) found family history of heart disease was linked to typical presentation. Finally, Canto et al. (2000) showed diabetics had a higher likelihood of atypical presentation. Milner et al. (2002) found diabetics had an increased likelihood of ACS but hypertensive patients, those with elevated cholesterol, and smokers did not. Braunwald et al. (2000) note, "Traditional risk factors for CAD (hypertension, cholesterol and smoking) are only weakly predictive of the likelihood of acute ischemia" (p. 6); whereas diabetes is a major risk factor.

History of Ischemic Heart Disease

Nearly half of the sample (n = 44, 44%) had a history of ischemic heart disease (IHD) defined as a documented history of UA or AMI. Patients with a history of IHD were just as likely to have typical as atypical presentations. Other studies have shown patients

with atypical presentations were less likely to have a history of IHD (Canto et al., 2002; Uretsky et al., 1977). Patients with history of IHD in this study had a significantly higher likelihood of having a final diagnosis of ACS. A prior history of AMI is reported to be associated with a higher likelihood of ACS when patients present with suspicious symptoms (Braunwald et al., 2000; Milner et al., 2002).

Prior Health Care Seeking Behavior

Twenty-five of the patients (25%) presenting to the CPP had sought care at a primary, community, or tertiary care provider for similar symptoms within the previous 30 days. Six of these 25 (24%) patients presented typically and 19 (76%) had atypical presentations; this relationship was not significant. Furthermore, 11 of 25 patients who previously sought care (44%) had a final diagnosis of ACS, while 14 (56%) had NACS. Again, a significant relationship was not seen. No mention of health care seeking behavior was found in the literature in terms of symptom presentation in ACS.

Diagnostic Findings

Electrocardiogram (ECG), cardiac markers, exercise testing (ETT), nuclear imaging (MIBI), stress echocardiography (echo), and coronary angiography (CA) results were recorded for study patients. There were no significant relationships between diagnostic findings and symptom presentation. Patients with a positive ECG at both 0 and 6 hour intervals, positive Troponin I at 6 hours, positive MIBI scan, or positive CA had a significantly higher likelihood of ACS. This is expected as patients were assigned a diagnosis of ACS based on positive findings. There was discussion in the literature about rate of diagnostic investigations completed for typical versus atypical presentation, usually based on gender or age, i.e., whether one group received more aggressive risk

stratification. There was no reference to the relationship to presentation or final diagnosis based on positive or negative results as was presented in this study.

A total of five patients had positive ECG; all five had a diagnosis of ACS. Two of two patients with positive CK/CK-MB, three of four with positive Troponin I at 0 hour, and eight of eight with positive Troponin I at 6 hours had a final diagnosis of ACS.

Exercise testing (ETT) was performed on 49% of the patients; eleven (22.4%) were positive, 20 (40.8%) negative, and 18 (36.7%) inconclusive. Two of the 11 patients with a positive ETT had a typical presentation and four of 11 had ACS. Of the 20 patients with a negative ETT, three had typical presentations and none had a final diagnosis of ACS. Finally, of the 18 inconclusive tests, 1 patient had a typical presentation and 5 had ACS. The numbers for ETT were insufficient for subgroup analysis.

MIBI scanning was performed on patients that were unable to undergo ETT due to physical limitations or because the ETT would be uninterpretable due to baseline ECG, following inconclusive ETT if clinically warranted, or after admission in some cases. A total of 29 MIBI scans were performed of which 8 (27.6%) were positive (ACS) for cardiac ischemia and 21 (72.4%) were negative (NACS). Only one of the 8 patients with a positive MIBI scan had a typical presentation. Stress echo was performed in place of MIBI scanning on four patients (physician preference); one (25%) was positive for cardiac ischemia (ACS) and three (75%) were negative (NACS). Neither the patient with ACS nor the other three had typical presentations.

Finally, CA was performed on 21 patients; 15 were positive (ACS), and 6 were negative (NACS). Of interest, all six patients with negative CA were female. Four of the

15 patients with a positive CA, and one of the six with a negative CA had a typical presentation.

Nurse Practitioner Impression of the Likelihood of ACS

An attempt was made to poll the ED physician, Cardiologist, and NP (the researcher) for their estimate of the patient's likelihood of ACS based upon their initial impression. Unfortunately, in the majority of cases, the ED physician and Cardiologist were not available and therefore, these data were not analyzed. However, the NP did classify 63 patients according to high or low likelihood for ACS. This assessment was done after taking the patient's history and prior to any provocative testing; i.e., ETT or MIBI. Thirty-one patients (49.2%) were classified as high likelihood for ACS and 32 (50.8%) as low likelihood. Nine of the 31 assigned a high likelihood also had typical presentations; patients assigned high likelihood by the NP were significantly more likely to have typical presentations. Eighteen of the 63 patients had a final diagnosis of ACS. Of the 31 patients assigned a high likelihood of ACS, 16 (51.6%) had a final diagnosis of ACS; whereas, only 2 (6.3%) of the 32 patients assigned a low likelihood of ACS had a final diagnosis of ACS. In other words, 16 of the 18 patients (88.9%) with ACS, and 30 of 45 (66.7%) with NACS were correctly identified by the NP; this finding was significant. There were no references found in the literature that looked at NP ability to identify ACS based on symptom history.

Limitations of the Study

The use of a convenience sample for this study limits generalization of findings to a similar population. As only patients of moderate risk for ACS are enrolled in the CPP, generalization to all patients with ACS is not possible. However, it does provide insight into symptom presentation in a previously unstudied cohort of patients. Causal

relationships cannot be determined from a comparative study design, although a closer appraisal of the relationship among variables is afforded. Subtle differences in symptom presentation between patients with UA and NSTEMI could not be examined, as small numbers did not allow for subgroup analysis.

Few patients in the study had a chief complaint other than chest pain. This is inconsistent with the findings of other studies that examined atypical presentation (Canto et al., 2002; Gupta et al., 2002). Patients with non-chest pain angina equivalents may not be recognized for enrollment into the CPP.

The definition chosen for typical presentation was based on the traditional definition for angina or discomfort of ischemic origin. These criteria resulted in a low percentage of patients with typical presentations in this study. Other studies have defined typical presentation more broadly (Canto et al., 2000; Canto et al., 2002; Gupta et al., 2002; Milner et al., 2001; Milner et al., 2002). In fact, it became apparent to the researcher, after the first 10 or so patients, how difficult it was to remain unbiased and stick to the strict study definition versus one's personal impression of typical versus atypical. To control for this, the study definition for typical presentation was added to the data collection tool to review for each patient prior to coding the presentation as typical or atypical (Appendix D). In addition, a random sample of 28 patients was independently reviewed by the thesis supervisor for percentage agreement on typical versus atypical presentation. However, the possibility remains that patients were coded incorrectly.

There is a chance that patients were misdiagnosed, that is, patients with ACS were given the diagnosis of NACS or vice versa. Eighteen study patients were discharged from the ED with a diagnosis of NACS without completing any provocative testing. There is a small possibility that some of these patients could have had ACS. As

well, for patients who underwent ETT or MIBI, the results were used to assign a diagnosis of ACS versus NACS; however, there is a chance that false negatives or false positives occurred. In a meta-analysis of studies without work-up bias, i.e., patients studied agreed to both ETT and CA, the sensitivity and specificity of ETT was approximately 50% and 90% respectively (Gibbons et al., 2002); the sensitivity and specificity of MIBI is approximately 91% and 73% respectively (Wackers et al., 1997). For patients admitted to hospital with a diagnosis of ACS, the discharge summary was reviewed for evidence to confirm the diagnosis, e.g., CA or MIBI result, Troponin I elevation, etc. Again, there is a small possibility there were errors in test results and consequently final diagnosis. Finally, as only one NP was involved in this study, the ability of the NP to predict the diagnosis of ACS based on symptom presentation cannot be generalized beyond this study.

Implications of the Findings

Acute coronary syndrome can be challenging to diagnose. The study findings support the literature in that many patients with ACS do not present with a classic history of exertional, retrosternal pressure. Often they have chest discomfort that is atypical in location or quality, or have symptoms other than chest pain. The traditional definition of angina does not adequately encompass these subtleties.

The traditional definition for ischemic discomfort includes location, quality, and radiation of discomfort, exacerbation by physical or emotional stress, and relief by rest or nitroglycerine as classic symptoms. In this study, the only factors significantly related to a final diagnosis of ACS included male gender, symptom location, and a prior history of IHD. No symptom qualities were significantly related to ACS; however, there was a trend toward the quality of 'squeezing' being related to NACS. No relationship between

radiation and ACS, nor between relief with rest or nitroglycerine and ACS, was found in this study. There was a trend toward a relationship between exertion/stress and ACS, but it was not statistically significant. Therefore, based on the traditional definition of ACS presentation, only one of the three classic features, location, contributed to the accuracy of diagnosis.

The breadth of symptom characteristics seen in this study emphasize the difficulty in applying a strict definition using a few classic symptoms to patients with a likelihood of ACS. A 'judgement call' based on a thorough health history will always be part of the decision-making process for the likelihood of ACS, especially when dealing with a moderate risk cohort. Further research may elaborate on a symptom presentation profile for ACS.

Hindrances to identification and subsequent treatment of patients with ACS can be twofold. The health care provider may rely too heavily on classic symptoms of ischemic pain and not recognize or acknowledge patients presenting with atypical symptoms. Second, the patient may not heed symptoms that are different from what they have been told to expect as warning signs of heart attack. It is important to educate and emphasize to both health care providers and patients about typical, as well as atypical symptoms of ACS.

Finally, this study looked at a unique group of patients considered at moderate risk of having an ischemic etiology for their symptoms. This cohort is possibly the most challenging for identifying ACS, as patients that display high risk features (dynamic ECG changes or elevated cardiac markers) are easier to recognize, as are low risk patients with alternate causes to explain their symptoms. Further research in this population of moderate risk patients is warranted.

Conclusions

Failure to recognize ACS can result in serious complications, including death. The findings of this study were consistent with the literature where patients with ACS often have atypical presentations. Only 14% of patients had typical presentations; 86% presented with atypical symptoms. Three-quarters of the patients with a final diagnosis of ACS had an atypical presentation; although, patients with typical presentations were significantly more likely to have a final diagnosis of ACS than NACS. No significant differences were found in symptom presentation or final diagnosis by age, body mass index, ethnicity, cardiovascular risk factors, or prior health care seeking behavior. Patients with a history of ischemic heart disease had a significantly higher likelihood of having a final diagnosis of ACS, but no relationship to symptom presentation was identified. There were no significant differences between diagnostic findings and symptom presentation. However, patients with a final diagnosis of ACS were significantly more likely to have a positive electrocardiogram at both the 0 and 6 hour intervals, positive Troponin I at 6 hours, and positive MIBI or CA.

The majority of patients presenting to the Emergency Department with symptom patterns suggestive of ACS and subsequently enrolled in the CPP had atypical presentations. As well, of those who went on to be diagnosed with ACS, three times as many patients had atypical symptoms as typical symptoms. This study reinforces that the traditional definition of ichemic pain does not encompass the subtleties of symptom presentation among patients at moderate risk of ACS. The presence of two or three classic symptoms does not predict ACS, nor does their absence rule out the diagnosis. Clinicians should not depend on typical definitions of ischemic pain when evaluating patients with symptoms suspicious for ACS. In addition, patients need to understand

ACS may manifest as a variety of symptoms. While revision of the traditional definition of ACS presentation may or may not improve diagnostic accuracy, enhanced awareness of atypical presentation may increase the identification and subsequent evaluation of patients with ACS. Accuracy of diagnosis is likely part of a complex decision-making process that depends on expertise in the taking of a thorough history, as well as in flushing out subtle clues from the patient's symptoms. Further data is needed to fully characterize the symptom complex of ACS.

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APPENDIX A

University of Alberta Hospital Chest Pain Program Background Information

The assessment and management of patients presenting to the Emergency Department (ED) with chest discomfort is often challenging. Limited hospital beds result in a significant number of patients undergoing prolonged assessment in the ED to help ensure safety of discharge. The Chest Pain Program (CPP), operated collaboratively by an Advanced Nurse Practitioner, ED Nurse, ED Physician and Cardiologist, is an evidence-based standardized protocol approach to patients presenting with symptoms suspicious for acute coronary syndrome (ACS). The goal is to maximize patient assessment in a safe and cost effective manner while minimizing ED length of stay, unnecessary hospital admissions, and inadvertent discharge of patients at high risk of cardiac events.

Individuals considered to be at moderate risk for ACS are enrolled in the program. Moderate risk patients have no high risk features to warrant admission to hospital (dynamic ECG changes, hemodynamic instability, or elevated cardiac markers) but meet one of five inclusion criteria: 1) prior history of ischemic heart disease, 2) 30 years of age or older with diabetes mellitus, 3) 50 years of age or older with two or more cardiovascular risk factors, 4) 60 years of age or older with one or more risk factors, or 5) no alternate clinical diagnosis more likely than ACS. Once enrolled in the CPP, individuals are observed for a minimum six hours, with repeat cardiac markers and ECG at this time, to rule out acute myocardial infarction (see CPP standing orders attached). They then undergo exercise stress testing and/or if necessary nuclear imaging to differentiate patients at risk of further cardiac events. Patients are given an information sheet upon enrollment into the CPP, as well as on discharge from the program.

APPENDIX B

INFORMATION SHEET

A Comparison of Typical and Atypical Symptom Presentation in Acute Coronary Syndromes

Investigator: Ann Comeau, RN, MN Candidate
Faculty of Nursing
University of Alberta
OPR 3T1.14 780-407-3173

Supervisor: Louise Jensen, RN, PhD
Professor, Faculty of Nursing
University of Alberta
4–112 CSB 780-492-6795

Introduction:
You are being asked to participate in a study to evaluate the symptoms patients have that may be related to heart disease. Patients with heart disease often have chest pain but some patients do not. As well, not all patients with chest pain have heart disease. This study will help our understanding of the symptoms of patients with heart disease.

Requirements and procedures:
As part of your assessment in the Emergency Department, a history of your symptoms will be obtained. You will be asked to describe the symptoms that brought you to the hospital. This includes what the symptom was, where it was, how bad it was, how long it lasted, what you were doing when it started, and anything that made it better or worse. This study will also include a review of your health information by the researcher including your age and any laboratory or test results, in order to match your symptoms to your diagnosis.

Potential benefits:
A better understanding of the symptoms of heart disease may help us recognize patients with heart disease.

Time requirements and potential risks:
The history will take approximately 10 – 15 minutes to complete. The questions asked about your symptoms would be the same as what a nurse or doctor asks when they take your admission history in the Emergency Department. There are no risks to being in this study.

Confidentiality and participation:
All information will be kept private, except when professional codes of ethics or the law requires reporting. The information you provide will be kept for at least five years after the study is done. The information will be kept in a locked filing cabinet in the researcher's office in the Clinical Sciences Building. Your name or any other identifying information will not be attached to the information you gave. Your name will also never be used in any presentations or publications of the study results. Your participation in this study is voluntary. You may refuse to answer any questions or have your health information reviewed. You may refuse to participate or you may withdraw from the study at any time without affecting the medical care you are entitled to receive.

Contact persons:
You may contact Ann Comeau at 780-407-3173 if you have any study-related questions.
If you have any concerns about any aspect of the study, you may contact the Patient Relations Department of the Capital Health Authority at 407-1040.

_____ _____

Participant's Initials **Researcher's Initials**

APPENDIX C

CONSENT FORM

Part 1:

Title of project: A Comparison of Typical and Atypical Symptom Presentation in Acute Coronary Syndromes

Investigator: Ann Comeau, RN, MN Candidate
Faculty of Nursing
University of Alberta
OPR 3T1.14 780-407-3173

Supervisor: Louise Jensen, RN, PhD
Professor, Faculty of Nursing
University of Alberta
4–112 CSB 780-492-6795

Part 2 (to be completed by the research subject):

Do you understand that you have been asked to be in a research study?	Yes No
Have you read and received a copy of the attached information sheet?	Yes No
Do you understand the benefits and risks involved in taking part in this research study?	Yes No
Have you had an opportunity to ask questions and discuss the study?	Yes No
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason and it will not affect your care.	Yes No
Has the issue of confidentiality been explained to you? Do you understand who will have access to your records/information?	Yes No

This study was explained to me by: _____

I agree to take part in this study.

_____ _____
Signature of Research Participant Date

_____
Printed Name

I believe that the person signing this form understands what is involved in this study and voluntarily agrees to participate.

_____ _____
Signature of Investigator Date

_____
Printed Name

APPENDIX D

Data Collection Tool

Demographics: **STUDY ID# _____**

Hospital ID # _____
Age: _____ ☐< 65 ☐ ≥ 65
Hgt: _____ Wgt: _____ BMI: ☐ ≤ 27 ☐ > 27
Gender: ☐ Male ☐ Female
Ethnicity: ☐ Caucasian ☐ African Canadian ☐ Asian ☐ South Asian ☐ Other _____

Historical:

Cardiovascular risk factors:

DM:	☐ yes	☐ no	
HTN:	☐ yes	☐ no	☐ unknown
↑ Lipids:	☐ yes	☐ no	☐ unknown
Smoker:	☐ yes	☐ no	
Fam Hx:	☐ yes	☐ no	☐ unknown

Previous history of IHD: ☐ yes ☐ no

Presenting Symptoms: CC:_____
Quality _____
Location _____
Radiation _____
Duration _____
Aggravating factors _____
Alleviating factors_____
Associated symptoms:
☐ SOB ☐ Sweating ☐ Syncope ☐ Dizziness/lightheadedness/unsteadiness
☐ Nausea/Vomiting ☐ Palpitations
Other:_____
_____

Came on with activity	☐ yes	☐ no
Ongoing at presentation	☐ yes	☐ no
Prior episodes	☐ yes, (if yes ☐ similar ☐ dissimilar)	☐ no
Reproduced with palpation	☐ yes	☐ no
Change with respiration	☐ yes	☐ no
Localized to one finger width	☐ yes	☐ no
Relieved by ntg/rest	☐ yes	☐ no

Other: _____
_____

☐ Typical ☐ Atypical

Typical Presentation – Chest pain that is substernal or retrosternal (may radiate to neck, jaw, epigastrium, or arms) with a characteristic quality (squeezing, pressurelike, heavy), may be reproducible by physical exertion or emotional stress, and usually relieved with rest or nitroglycerine (Gibbons et al., 1999); chest pain may occur at rest (Braunwald et al., 2000).

Health seeking past 30 days: ☐ yes (☐ adm to hospital) ☐ no

Likelihood of ACS diagnosis:

ED physician ☐ high ☐ moderate ☐ low ☐ not available
Cardiologist ☐ high ☐ moderate ☐ low ☐ not available
ANP ☐ high ☐ moderate ☐ low ☐ not available

Diagnostic Findings:

ECG at 0 hour: ☐ pos ☐ neg
ECG at 6 hour: ☐ pos ☐ neg

CK, CK-MB at 0 hour: ☐ pos ☐ neg
Troponin at 0 hour: ☐ pos, value_____ ☐ neg
Troponin at 6 hour: ☐ pos, value_____ ☐ neg

EST: ☐ pos ☐ neg ☐inconclusive
☐ not done
(☐ uninterpretable ECG ☐ unable to exercise ☐ low risk by hx
☐ high risk by hx ☐ pos trop ☐ pos ECG)

MIBI: Date _____
☐ pos ☐ neg ☐inconclusive
☐ not done (☐ no show ☐not needed/low risk ETT)

Final diagnosis: ☐ ACS (☐ UA ☐ NSTEMI) ☐ NACS